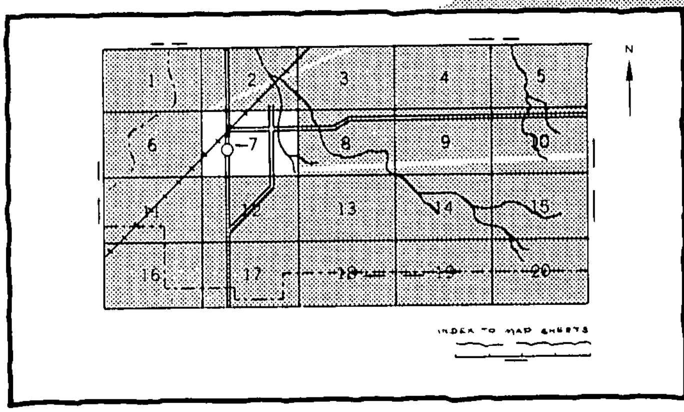
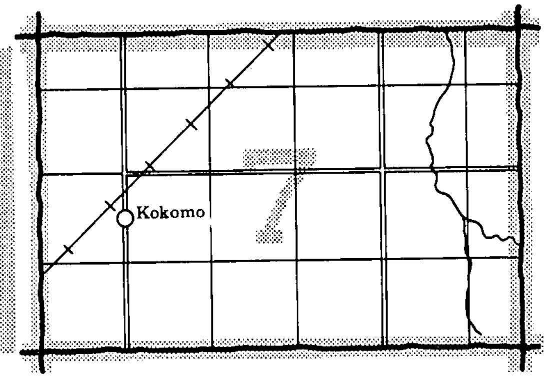
Soil Survey of
Dunn County, North Dakota

United States Department of Agriculture
Soil Conservation Service
in cooperation with
United States Department of the Interior
Bureau of Indian Affairs
and
North Dakota Agricultural Experiment Station

HOW TO USE

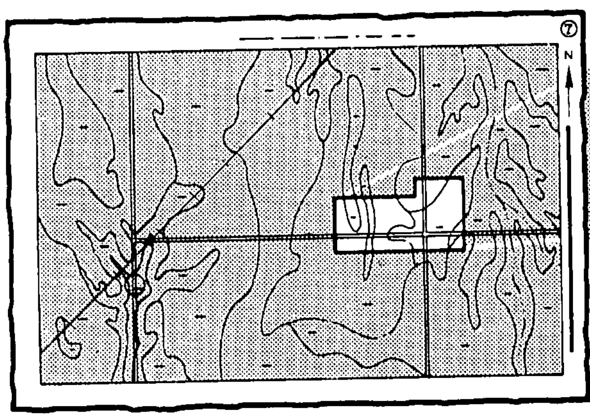
1. Locate your area of interest on the "Index to Map Sheets" (the last page of this publication).

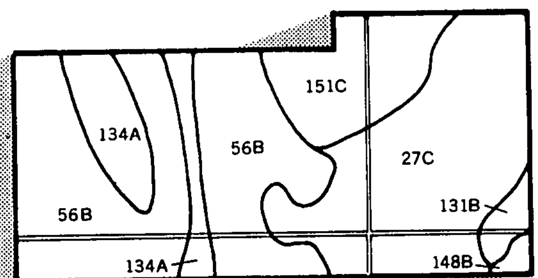




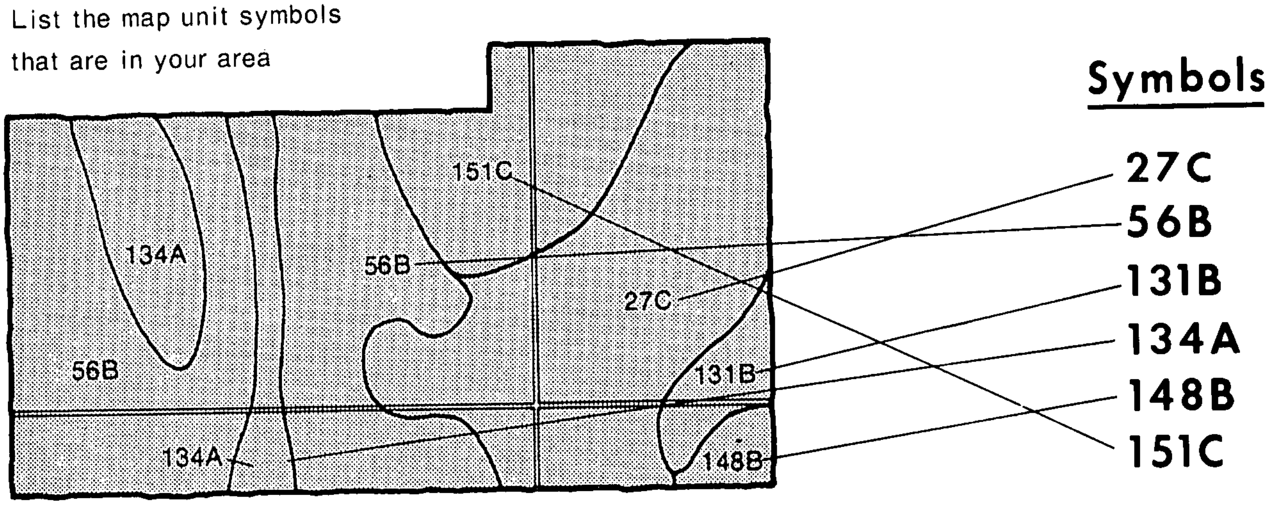
2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.



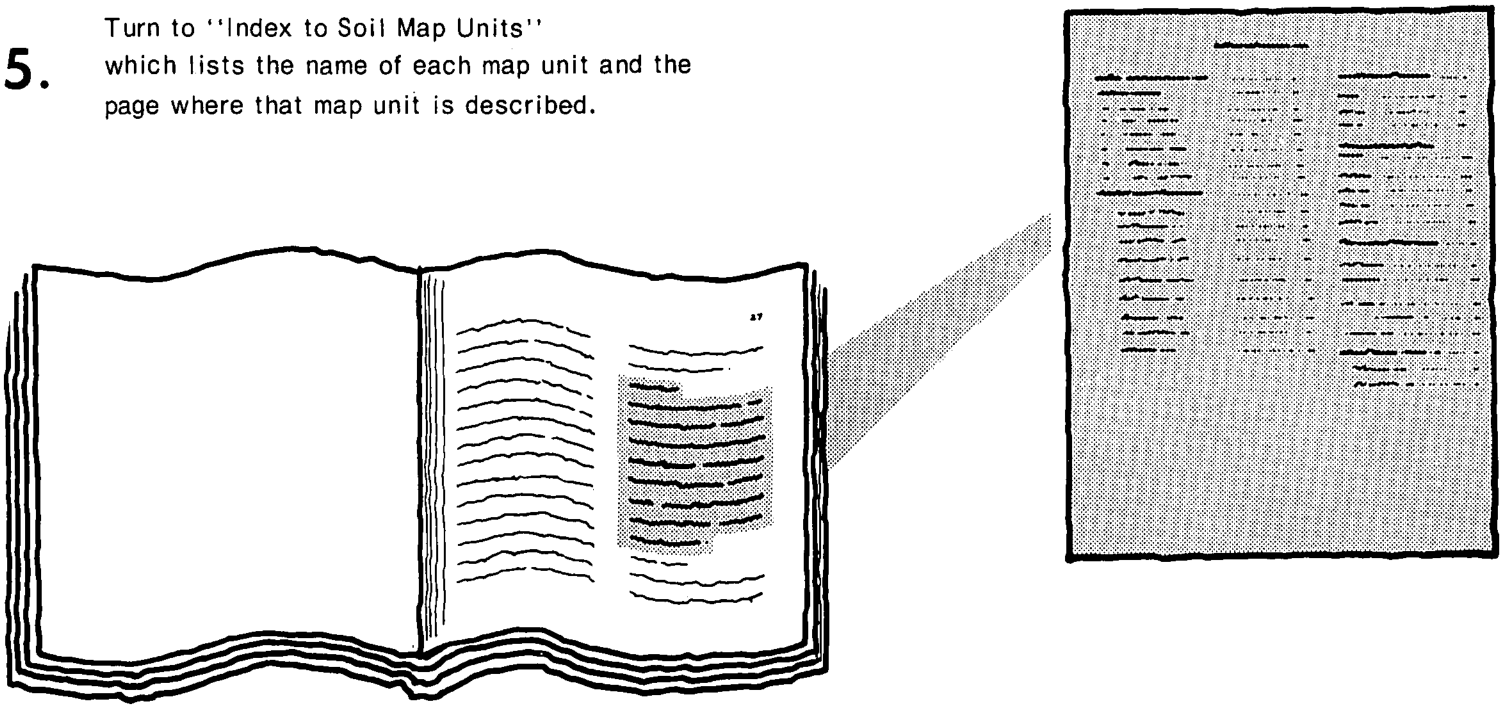


4. List the map unit symbols that are in your area

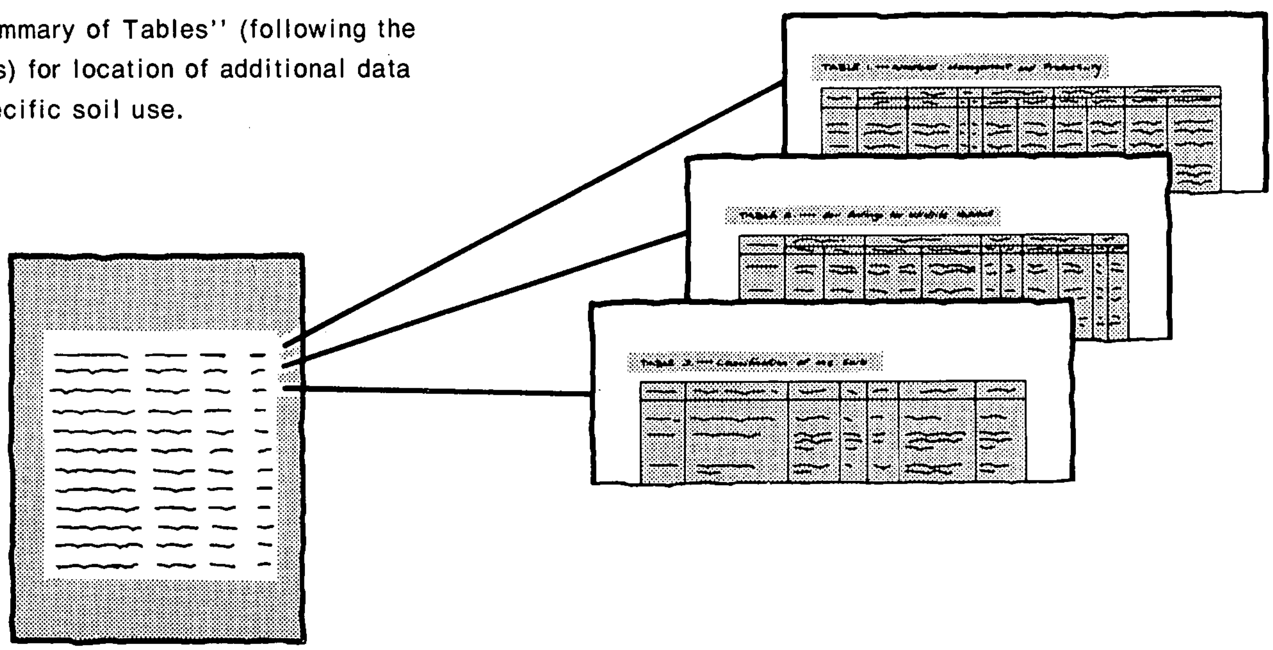


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; for specialists in wildlife management, waste disposal, or pollution control.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

This survey was made cooperatively by the Soil Conservation Service; the North Dakota Agricultural Experiment Station; and the United States Department of the Interior, Bureau of Indian Affairs. It is part of the technical assistance furnished to the Dunn County Soil Conservation District. Financial assistance was provided by Dunn County Water Management Board, Dunn County Commissioners, North Dakota State Soil Conservation Committee, and the Old West Regional Commission. Major fieldwork was performed in the period 1973-1980. Soil names and descriptions were approved in 1980. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1980.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

Cover: Vebar and Parshall soils, foreground, are used for crops and hay. Conservation tillage that leaves crop residue on the surface protects the soil from blowing. Cabba and Cohagen soils and Badland, background, are used as rangeland.

contents

Index to map units v
Summary of tables vii
Foreword ix
General nature of the survey area 2
How this survey was made 4
General soil map units 5
Soil descriptions 5
Detailed soil map units 19
Soil descriptions 19
Prime farmland 78
Use and management of the soils 81
Crops and pasture 81
Rangeland 84
Woodland, windbreaks, and environmental plantings 85
Recreation 85
Wildlife habitat 87
Engineering 88
Soil properties 93
Engineering index properties 93
Physical and chemical properties 94
Soil and water features 95
Engineering index test data 96
Classification of the soils 97
Soil series and their morphology 97
Formation of the soils 127
References 131
Glossary 133
Tables 139

soil series

Amor series 97
Arikara series 98
Arnegard series 99
Baahish series 99
Banks series 100
Belfield series 100
Bowdle series 101
Brandenburg series 101
Cabba series 102
Chama series 102
Cherry series 103
Cohagen series 103
Colvin series 104
Daglum series 104
Dimmick series 105
Ekalaka series 106
Farland series 106
Flaxton series 107
Grail series 108
Harriet series 108
Havrelon series 109
Heil series 109
Hidatsa series 110
Lakoa series 111
Lawther series 111
Lefor series 112
Lihen series 112
Moreau series 113
Moreau Variant 113
Morton series 114
Noonan series 114
Parshall series 115
Regent series 115
Rhoades series 116
Ruso series 116
Savage series 117
Searing series 118
Sen series 118
Shambo series 119
Straw series 119
Temvik series 120
Tonka series 120
Trembles Variant 121
Vanda series 121
Vebar series 122
Velva series 122
Wabek series 123
Watrous series 123
Wayden series 124
Williams series 124
Zahl series 125

Issued April 1982

index to map units

3—Straw loam, channeled ... 19
4—Arnegard loam, 1 to 3 percent slopes ... 20
4B—Arnegard loam, 3 to 6 percent slopes ... 20
5—Tonka silt loam ... 21
7—Straw-Rhoades loams ... 21
8C—Cabba-Chama silt loams, 6 to 9 percent slopes 22
9D—Amor-Cabba loams, 9 to 15 percent slopes ... 22
9E—Cabba loam, 15 to 45 percent slopes ... 23
10D—Cabba extremely stony loam, 3 to 25 percent slopes ... 23
11F—Cabba-Badland complex, 15 to 120 percent slopes ... 24
12—Banks loamy sand, 1 to 3 percent slopes ... 24
13D—Wabek gravelly loam, 1 to 15 percent slopes .. 25
15—Belfield-Farland silt loams, 1 to 3 percent slopes ... 25
16B—Belfield-Savage silty clay loams, 1 to 6 percent slopes ... 26
18—Belfield-Grail silty clay loams, 1 to 3 percent slopes ... 27
19B—Belfield-Morton silt loams, 1 to 6 percent slopes ... 27
21B—Cherry silty clay loam, 1 to 6 percent slopes.... 28
21C—Cherry silty clay loam, 6 to 9 percent slopes.... 28
22—Colvin silt loam, saline ... 30
24—Dimmick clay ... 30
25F—Baahish-Rock outcrop complex, 15 to 120 percent slopes ... 31
27—Farland silt loam, 1 to 3 percent slopes ... 32
27B—Farland silt loam, 3 to 6 percent slopes ... 32
29B—Farland-Rhoades silt loams, 1 to 6 percent slopes ... 33
30E—Cohagen-Vebar fine sandy loams, 9 to 25 percent slopes ... 34
31F—Cohagen-Vebar-Rock outcrop complex, 15 to 40 percent slopes ... 34
32B—Flaxton-Williams complex, 1 to 6 percent slopes ... 35
32C—Flaxton-Williams complex, 6 to 9 percent slopes ... 35
33—Grail silt loam, 1 to 3 percent slopes ... 36
33B—Grail silt loam, 3 to 6 percent slopes ... 36
35—Lawther silty clay, 1 to 3 percent slopes ... 37
35B—Lawther silty clay, 3 to 6 percent slopes ... 37
37—Trembles Variant fine sandy loam ... 38
39—Havrelon silt loam ... 38
40—Havrelon silt loam, channeled ... 39
41—Heil silty clay loam ... 39
42B—Lefor fine sandy loam, 1 to 6 percent slopes... 40
42C—Lefor fine sandy loam, 6 to 9 percent slopes... 40
43B—Havrelon silt loam, fan, 1 to 6 percent slopes.. 41
44B—Lihen loamy fine sand, 1 to 6 percent slopes... 41
44D—Lihen loamy fine sand, 6 to 15 percent slopes 42
45B—Ruso sandy loam, 1 to 6 percent slopes ... 42
45C—Ruso sandy loam, 6 to 9 percent slopes ... 43
46—Bowdle loam, 1 to 3 percent slopes ... 43
46B—Bowdle loam, 3 to 6 percent slopes ... 44
47—Moreau silty clay, 1 to 3 percent slopes ... 44
47B—Moreau silty clay, 3 to 6 percent slopes ... 45
47C—Moreau silty clay, 6 to 9 percent slopes ... 45
48B—Temvik silt loam, 3 to 6 percent slopes ... 46
49—Morton silt loam, 1 to 3 percent slopes ... 46
49B—Morton silt loam, 3 to 6 percent slopes ... 47
49C—Morton silt loam, 6 to 9 percent slopes ... 47
51C—Amor extremely stony loam, 1 to 9 percent slopes ... 48
52B—Morton-Rhoades silt loams, 1 to 6 percent slopes ... 48
52C—Morton-Rhoades silt loams, 6 to 9 percent slopes ... 49
53B—Watrous loam, 1 to 6 percent slopes ... 50
54B—Parshall fine sandy loam, 1 to 6 percent slopes ... 50
55—Pits ... 51
58—Regent silty clay loam, 1 to 3 percent slopes 51
58B—Regent silty clay loam, 3 to 6 percent slopes... 52
58C—Regent silty clay loam, 6 to 9 percent slopes .. 52
61B—Regent-Rhoades silty clay loams, 1 to 6 percent slopes ... 53
61C—Regent-Rhoades silty clay loams, 6 to 9 percent slopes ... 54
62B—Rhoades silt loam, 1 to 6 percent slopes ... 54
62D—Rhoades-Cabba loams, 9 to 15 percent slopes ... 55
64—Badland ... 55
67—Savage silty clay loam, 1 to 3 percent slopes..... 56
67B—Savage silty clay loam, 3 to 6 percent slopes .. 56
68—Vanda silty clay, 1 to 3 percent slopes ... 57
69B—Savage-Rhoades silty clay loams, 1 to 6 percent slopes ... 57
70C—Searing loam, 3 to 9 percent slopes ... 58
71B—Sen silt loam, 3 to 6 percent slopes ... 58
71C—Sen silt loam, 6 to 9 percent slopes ... 59
73C—Cherry-Vanda complex, 3 to 9 percent slopes, gullied ... 59
75—Straw loam ... 60
79—Velva fine sandy loam, 1 to 3 percent slopes..... 60

81B—Vebar-Parshall fine sandy loams, 1 to 6 percent slopes 61
81C—Vebar-Parshall fine sandy loams, 6 to 9 percent slopes 62
81D—Vebar fine sandy loam, 9 to 15 percent slopes 62
82D—Vebar extremely stony fine sandy loam, 3 to 15 percent slopes 63
83E—Baahish fine sandy loam, 9 to 50 percent slopes 63
84—Hidatsa loam, 1 to 3 percent slopes 64
84B—Hidatsa loam, 3 to 6 percent slopes 65
86F—Brandenburg-Cabba loams, 6 to 50 percent slopes 65
87F—Lakoa loam, 15 to 45 percent slopes 66
88—Williams loam, 1 to 3 percent slopes 66
88B—Williams loam, 3 to 6 percent slopes 67
88C—Williams loam, 6 to 9 percent slopes 67
90C—Williams extremely stony loam, 1 to 9 percent slopes 68
91B—Williams-Noonan loams, 3 to 6 percent slopes 68
91C—Williams-Noonan loams, 6 to 9 percent slopes 69
93C—Williams-Zahl loams, 6 to 9 percent slopes 70
93D—Zahl-Williams loams, 9 to 15 percent slopes 70
93E—Zahl-Williams loams, 15 to 25 percent slopes .. 71
94B—Moreau Variant clay loam, 1 to 6 percent slopes 71
94E—Wayden silty clay, 9 to 25 percent slopes 72
101B—Amor loam, 3 to 6 percent slopes 72
101C—Amor loam, 6 to 9 percent slopes 73
102—Shambo loam, 1 to 3 percent slopes 73
102B—Shambo loam, 3 to 6 percent slopes 74
105—Harriet silt loam 74
106B—Daglum silt loam, 1 to 6 percent slopes 75
107—Aquents, ponded 76
109B—Ekalaka fine sandy loam, 1 to 6 percent slopes 76
207F—Arikara loam, 9 to 75 percent slopes 77
209E—Cherry-Cabba complex, 9 to 25 percent slopes 77
211F—Badland-Cabba-Arikara complex, 25 to 120 percent slopes 78

summary of tables

Temperature and precipitation (table 1) 140
Freeze dates in spring and fall (table 2) 141
Probability. Temperature.
Growing season (table 3) 141
Probability. Daily minimum temperature.
Acreage and proportionate extent of the soils (table 4) 142
Acres. Percent.
Yields per acre of crops and pasture (table 5) 144
Spring wheat. Barley. Oats. Corn silage. Grass-legume hay.
Rangeland productivity and characteristic plant communities (table 6) 149
Range site. Total production. Characteristic vegetation. Composition.
Windbreaks and environmental plantings (table 7) 157
Recreational development (table 8) 168
Camp areas. Picnic areas. Playgrounds. Paths and trails.
Wildlife habitat (table 9) 175
Potential for habitat elements. Potential as habitat for—Openland wildlife, Wetland wildlife, Rangeland wildlife.
Building site development (table 10) 181
Shallow excavations. Dwellings without basements. Dwellings with basements. Small commercial buildings. Local roads and streets.
Sanitary facilities (table 11) 189
Septic tank absorption fields. Sewage lagoon areas. Trench sanitary landfill. Area sanitary landfill. Daily cover for landfill.
Construction materials (table 12) 197
Roadfill. Sand. Gravel. Topsoil.
Water management (table 13) 204
Limitations for—Pond reservoir areas; Embankments, dikes, and levees; Features affecting—Drainage, Irrigation, Terraces and diversions, Grassed waterways.
Engineering index properties (table 14) 211
Depth. USDA texture. Classification—Unified, AASHTO. Fragments greater than 3 inches. Percentage passing sieve—4, 10, 40, 200. Liquid limit. Plasticity index.

Physical and chemical properties of soils (table 15) 221
Depth. Permeability. Available water capacity. Soil reaction. Salinity. Shrink-swell potential. Erosion factors. Wind erodibility group.
Soil and water features (table 16)... 228
Hydrologic group. Flooding. High water table. Bedrock. Potential frost action. Risk of corrosion.
Engineering index test data (table 17) 234
Horizon and Depth. Classification. Grain-size distribution. Liquid limit. Plasticity index. Moisture density.
Classification of the soils (table 18)... 235
Family or higher taxonomic class.

Foreword

This soil survey contains information that can be used in land-planning programs in Dunn County. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations inherent in the soil or hazards that adversely affect the soil, improvements needed to overcome the limitations or reduce the hazards, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

J. Michael Nethery

J. Michael Nethery
State Conservationist
Soil Conservation Service

soil survey of
Dunn County, North Dakota

By M. Robert Wright, Jerome Schaar, Soil Conservation Service
and Steven J. Tillotson, North Dakota State Soil Conservation Committee

Fieldwork by M. Robert Wright, Jerome Schaar, Randy Moore,
Kenneth W. Thompson, Lawrence E. Edland, and Frederick P. Aziz,
Soil Conservation Service
Steven J. Tillotson, North Dakota State Soil Conservation Committee,
and Paul K. Weiser, Professional Soil Classifier

United States Department of Agriculture, Soil Conservation Service
in cooperation with
United States Department of the Interior, Bureau of Indian Affairs
and North Dakota Agricultural Experiment Station

Dunn County is in the west-central part of North Dakota (fig. 1). The county has a total area of 1,331,840 acres, of which 1,275,010 acres, or 1,992 square miles, is land and 56,830 acres is water. Most of the water is Lake Sakakawea.

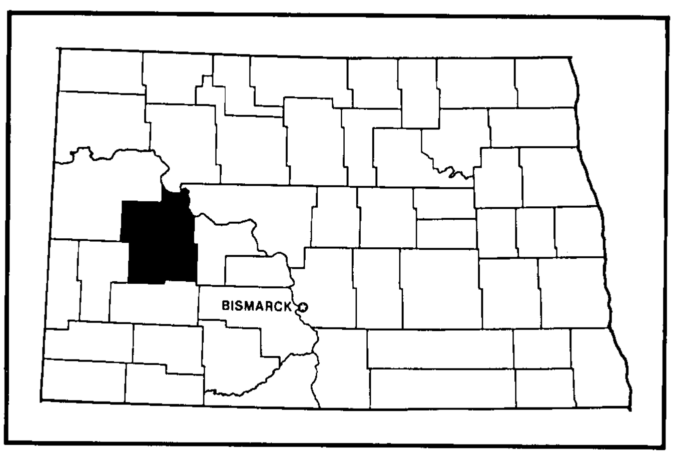


Figure 1.—Location of Dunn County in North Dakota.

The county is part of the Missouri Slope Vegetative Zone and the Rolling Soft Shale Plain Land Resource Area of the Northern Great Plains. It is within the Missouri River Basin. It is bounded on the north by Lake Sakakawea and McKenzie County, on the west by Billings and McKenzie Counties, on the south by Stark County, and the east by Mercer County. Dunn County includes a major part, about 280,000 acres, of the Fort Berthold Indian Reservation.

The Little Missouri River enters the county on the west and flows into Lake Sakakawea. Lake Sakakawea drains most of the northern part of the county. The Knife River crosses the south-central part of the county, and the Green River crosses the southwest corner. Other important drainage includes Squaw Creek and Moccasin Creek in the northern part of the county, Spring Creek and Little Knife River in the central part, and Crooked Creek and Deep Creek in the southern part.

The eastern and northern parts of Dunn County have remnants of glacial till that covered about three-fourths of the county (*3*). The western part of the county was not glaciated. The till is mainly thin and not continuous. Most of the county is covered by deposits from the Tertiary Period. These deposits consist mainly of soft shale, soft sandstone, and lignite. Slope ranges from

nearly level to hilly in the upland plains to very steep in the Badlands. The Badlands, an area of rapid geological erosion, is 6 to 8 miles wide and is along the Little Missouri River. Local relief ranges from 400 to 600 feet. The Little Badlands, considerably less rugged, is located about 8 miles south of Manning.

The Killdeer Mountains, in the northwest part of the county, rise about 700 feet above the plains. They cover about 22 square miles and are remnants of the youngest residual geological formation in North Dakota. Elevation ranges from about 1,840 feet at the level of Lake Sakakawea to the 3,314 feet at the top of the Killdeer Mountains.

The first soil survey of Dunn County was published in 1910 (*6*). This survey updates the earlier survey, provides additional information and larger scale maps, and shows the soils in more detail.

general nature of the survey area

This part of the publication provides general information on the settlement and history, natural resources, farming and ranching, and climate of Dunn County.

settlement and history

The settlement of Dunn County followed the general pattern of settlement of the Great Plains. Explorers, military expeditions, or private groups seeking economic advantage often came first. Then traders, hunters, and trappers came. Missionaries then arrived to establish missions and schools. Cattlemen moved into the area prior to settlement. The railroad generally preceded the largest influx of settlers.

Indian tribes were the first to visit what is now Dunn County. They came to hunt, especially near the Killdeer Mountains, and to dig for "Knife River flint" which was used to make points for tools and weapons. Lewis and Clark traveled up the Missouri River, along the present northern border of the county, during the years of 1804-1805. Later, hunters and trappers worked in the area because of the abundant game, and they established Fort Berthold (*5*).

The Indian tribes that lived in villages in the area included the Hidatsa, Mandan, and Arikaras. In 1870, the federal government bought Fort Berthold from the Northwest Fur Company, since the fur trade had steadily decreased, and established the Fort Berthold Indian Reservation. Missions were also established during this period (*5*).

When the railroad came through the western part of North Dakota, in 1880, ranchers settled in the area. They settled near rivers, near the Killdeer Mountains, and in sheltered areas. The first settlers bought provisions and marketed at Dickinson, Taylor, and Richardton, which were towns along the railroad and south of the present Dunn County.

The first large group of settlers, Bohemian immigrants from the Crimean Penninsula, moved into the southwestern part of the area in the middle 1890's. They settled in the area of New Hradec. Another large group of people to settle in what is now Dunn County came from Russia. These were mainly people of German origin, or Germans from Russia. Norwegians and lesser numbers of Austrians, Germans, Hungarians, Swedes, Canadians, Danes, and Romanians made up another large group of early settlers (*5*).

Before 1883, a large part of west-central North Dakota was called Howard County. Howard County was split in 1883 to form four counties, including Dunn County. The boundaries were changed again in 1885, and, in 1891, Dunn County became a part of Stark County. The present Dunn County was established in 1908 (*5*).

The population was 159 in 1890 and 5,302 in 1910. The population increased to 9,566 in 1930 and then began to decline. In 1980 it was 4,626, according to preliminary figures of the 1980 United States Census. Killdeer, the largest town, is located in the west-central part of the county and has a population of 791. Other towns and population figures are: Halliday, 355; Dunn Center, 169; and Dodge, 200.

natural resources

Soil is the most important natural resource in the county. Livestock that graze the grassland and crops produced on farms are marketable products that are affected by the soil. Oil, natural gas, and vast reserves of lignite coal are also important resources.

Most of the county has adequate water for domestic use and for use by livestock. Artesian aquifers are suitable for livestock, domestic use, and limited industrial uses but generally are not suitable for irrigation water. Glacial outwash and alluvial deposits, in valleys and stream channels throughout the county, form potentially productive aquifers for irrigation. Care is required to insure that both soils and water are suitable for sustained irrigation. Lake Sakakawea also contains large reserves of suitable water. Most of the water used on farms is derived from lignite coal veins. Water from streams is of limited value, except as a source for livestock, because the flow of water is low and the content of soluble salts is high (*4*).

The discovery of numerous oil fields in Dunn County since March 1976 indicates a potential for increased oil production in the area. The largest reserves of lignite coal in the state are estimated to be in Dunn County. During the 1950's, many mines were operated, both surface and underground, but commercial production has ceased.

A few areas of sand, gravel, and porcelanite, or scoria, have been mined in the county. The main use is for

surfacing secondary roads and as a base for paved highways. Clay from a member of the Golden Valley Formation is high in kaolinite, which is used commercially for making bricks, pottery, and powders. The Golden Valley Formation is moderately extensive in the county.

farming and ranching

The first settlers in Dunn County were mainly cattle and sheep ranchers. Prior to settlement, the grasslands were used for grazing by companies and individuals owning large herds of livestock. The livestock were driven through the county seeking grass and water in the open range. Today, most of the farms are diversified and derive income from cow-calf operations for beef or dairies and from small grain crops. A few operations grow mainly small grain, and several ranchers raise mainly cattle. The cattle ranches are along the Little Missouri River, Knife River, and on the Fort Berthold Indian Reservation. The cattle ranchers raise oats and barley for feed and grasses and legumes for forage.

The number of farms in the county increased until the thirties. The depression and prolonged drought of the thirties forced many landowners to give up farming and to go west to seek work. The number of farms decreased from about 1,564 in 1935 to about 1,157 in 1954. The decrease continued during the period of 1954 through 1980 but at about half the previous rate. In 1974, a total of 792 farms were managed by 725 different operators. The average farm and ranch size, according to the United States Bureau of Census, 1974 Census of Agriculture, North Dakota State and County Data, was about 815 acres in 1935, 1,100 acres in 1954, and 1,610 acres in 1974. Generally, livestock ranches are considerably larger than the diversified farms. In 1980, according to the Agricultural Stabilization and Conservation Service, 874 farms had 650 operators.

About 462,000 acres, or 36 percent of the land area, is used as cropland. The rest is mostly in native grass and is used as rangeland or for hay. The major crop planted is hard red spring wheat that has an average yield of 22 bushels per acre. Other commonly grown cash crops are barley, flax, and sunflowers. Crops that are used primarily as feed for livestock are oats, corn cut for silage, alfalfa, tame grasses, and sweet clover.

The New Hradec-Hirschville Soil Conservation District was organized in 1944. It covered 8 townships in the southwestern part of the county. The remaining part of the county was organized in 1946. The New Hradec District merged with the Dunn County Soil Conservation District in 1955. The Soil Conservation Service furnishes technical assistance to the district.

climate

Prepared by National Climate Center, Asheville, North Carolina.

Dunn County is usually quite warm in summer and has frequent spells of hot weather and occasional cool days. It is very cold in winter, when arctic air frequently surges over the area. Most precipitation falls during the warm period and is normally heaviest in the late spring and early summer. Winter snowfall is normally not too heavy. It is blown into drifts so that much of the ground is free of snow.

Table 1 gives data on temperature and precipitation for the survey area, as recorded at Dunn Center, North Dakota, for the period 1951 to 1976. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on the length of the growing season.

In winter the average temperature is 13 degrees F, and the average daily minimum temperature is 2 degrees. The lowest temperature on record, which occured at Dunn Center on January 31, 1959, is -46 degrees. In summer the average temperature is 66 degrees, and the average daily maximum temperature is 80 degrees. The highest recorded temperature, which occurred on July 21, 1960, is 107 degrees.

Growing degree days, shown in Table 1, are equivalent to heat units. During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (40 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

Of the total annual precipitation, 14 inches, or 80 percent, usually falls in April through September, which includes the growing season for most crops. In 7 years out of 10, the rainfall in April through September is less than 11 inches. The heaviest 1-day rainfall during the period of record was 3.73 inches at Dunn Center on August 30, 1964. Thunderstorms occur on about 30 days each year, and most occur in summer.

Average seasonal snowfall is 38 inches. The greatest depth of snow at any one time during the period of record was 33 inches. On the average, 54 days have at least 1 inch of snow on the ground. But the number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 60 percent. Humidity is higher at night, and the average at dawn is about 80 percent. The percentage of possible sunshine is 70 in summer and 50 in winter. The prevailing wind is from the southwest. Average windspeed is highest, 11 miles per hour, in spring.

Storms with snow and high wind bring blizzard conditions several times each winter. Hail during summer thunderstorms occurs in small, scattered areas.

how this survey was made

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; and the kinds of rock. They dug many holes to study soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material, which has been changed very little by leaching or by plant roots.

The soil scientists recorded the characteristics of the profiles they studied and compared those profiles with others in nearby counties and in more distant places. They classified and named the soils according to nationwide uniform procedures. They drew the boundaries of the soils on aerial photographs. These photographs show trees, buildings, fields, roads, and other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units in this survey area are described under "General soil map units" and "Detailed soil map units."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data are assembled from other sources, such as test results, records, field experience, and state and local specialists. For example, data on crop yields under defined management are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it can be used by farmers, rangeland managers, engineers, planners, developers and builders, home buyers, and others.

general soil map units

The general soil map at the back of this publication shows broad areas called associations that have a distinctive pattern of soils, relief, and drainage. Each soil association on the general soil map is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in other associations but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

As a result of changes in series concepts, differing soil patterns, and differences in the design of map units some of the boundaries and soil names on the Dunn County general soil map do not match those on the general soil maps of Stark and Mercer Counties.

soil descriptions

Dominantly shallow, nearly level to very steep soils on uplands

The associations in this group consist of soils which formed in material weathered from siltstone, sandstone, and porcelanite or which formed in alluvium. The four associations in this group make up about 40 percent of the county. They are well suited to rangeland, poorly suited to cultivated crops and septic tank absorption fields, and generally suited to sites for buildings.

1. Cabba-Cohagen-Rhoades association

Well drained, somewhat excessively drained, and moderately well drained, shallow and deep, moderately coarse textured and medium textured soils which formed in material weathered from siltstone and sandstone or which formed in alluvium

This association consists of hilly, dissected upland, narrow side slopes, and broad foot slopes adjacent to drainageways. Most areas of this unit are drained by well defined, intermittent streams. Slope ranges from 1 to 45 percent.

This association makes up about 13 percent of the county. It is about 35 percent Cabba and similar soils, 15 percent Cohagen and similar soils, and 10 percent Rhoades and similar soils (fig. 2). The remaining 40 percent is minor soils.

The moderately sloping to very steep Cabba soils are on ridges and hills. They have a surface layer of loam and a substratum of silt loam. Soft siltstone bedrock is at a depth of about 18 inches.

The strongly sloping to very steep Cohagen soils are also on ridges and hills. They have a surface layer and substratum of fine sandy loam. Soft sandstone bedrock is at a depth of about 15 inches.

The nearly level to strongly sloping Rhoades soils are on side slopes and foot slopes and in swales. They are below the Cabba and Cohagen soils. They have a surface layer of silt loam, a subsoil of silty clay loam, and a substratum of silty clay and clay.

The most extensive minor soils in this association are the Amor, Morton, and Vebar soils and the miscellaneous areas of Badland. The gently sloping to strongly sloping Amor and Morton soils are medium textured. The gently sloping to strongly sloping Vebar soils are moderately coarse textured. The very steep Badland consists of barren, eroding shale beds. The Amor and Vebar soils are on side slopes and foot slopes. Morton soils are on side slopes.

This soil association is used mainly as rangeland. In places the gently sloping and moderately sloping soils are used to grow small grain and legumes. Sparse stands of native trees and shrubs are along some drainageways. They provide food for wildlife and cover for wildlife and livestock. Rooting depth is limited by the soft bedrock. The hazards of water erosion and soil blowing are high. Droughtiness, high runoff, low available water capacity, and the presence of sodium salts are the main limitations to argicultural use.

This association is suited to sites for buildings, is poorly suited to septic tank absorption fields and cultivated crops, and is well suited to rangeland.

2. Cohagen-Vebar association

Somewhat excessively drained and well drained, shallow and moderately deep, moderately coarse textured soils that formed in material weathered from sandstone

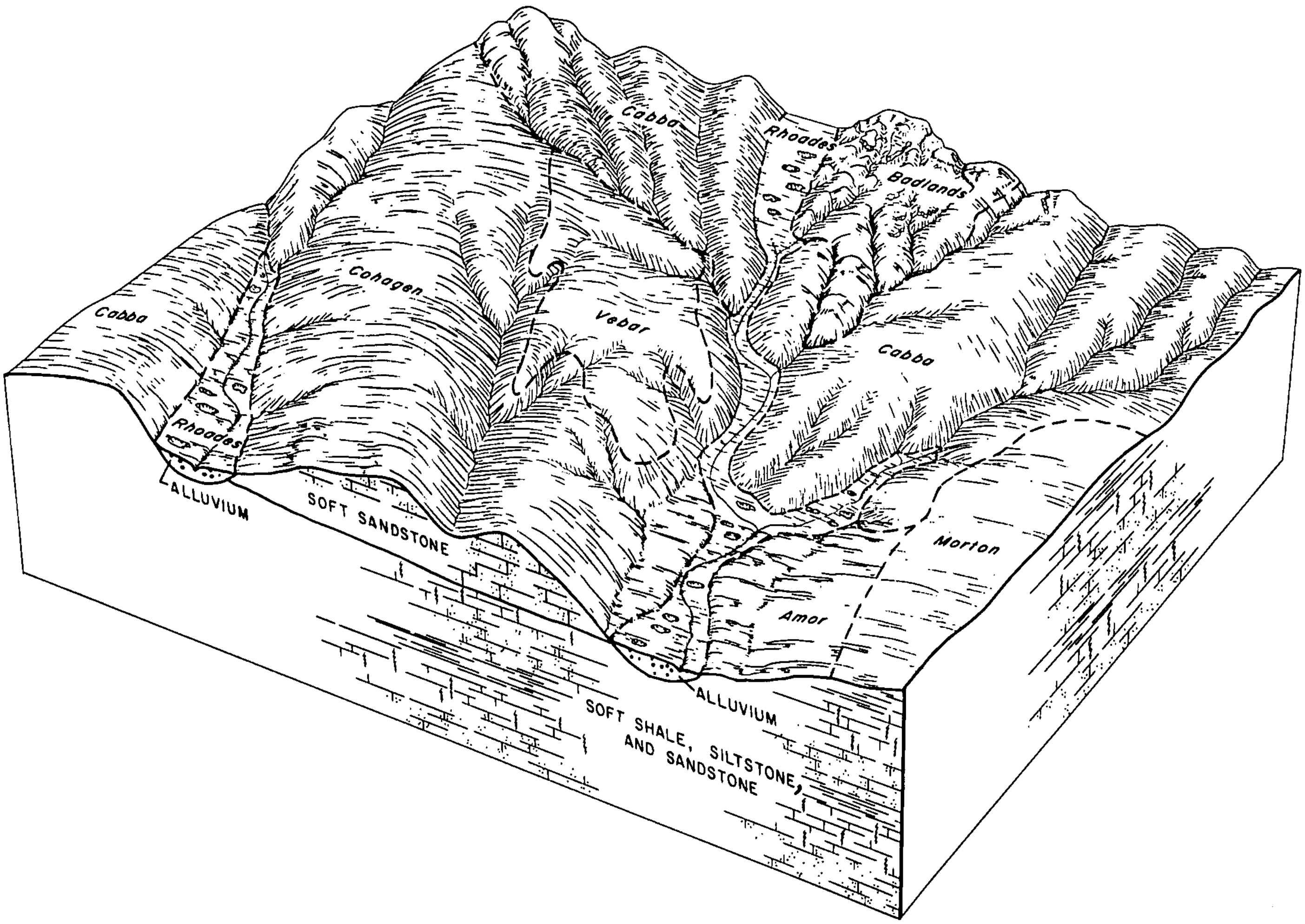


Figure 2.—Typical pattern of soils and underlying material in the Cabba-Cohagen-Rhoades association.

This association consists of hilly, dissected upland. Most areas of this unit are drained by well defined, intermittent streams. Slope ranges from 1 to 40 percent.

This association makes up about 10 percent of the county. It is about 45 percent Cohagen and similar soils and 25 percent Vebar and similar soils. The remaining 30 percent is soils of minor extent.

The strongly sloping to very steep Cohagen soils are on ridges and hills. They have a surface layer and substratum of fine sandy loam. Soft sandstone bedrock is at a depth of about 15 inches.

The nearly level to moderately steep Vebar soils are on side slopes and foot slopes. They are below the Cohagen soils. They have a surface layer, subsoil, and substratum of fine sandy loam. Soft sandstone bedrock is at a depth of about 38 inches.

The most extensive minor soils in this association are the Amor, Parshall, and Rhoades soils. The gently sloping and moderately sloping Amor soils are medium textured. They are on foot slopes and side slopes. The nearly level to moderately sloping Parshall soils are moderately coarse textured and have a dark colored surface layer that is more than 16 inches thick. They are in swales. The gently sloping and moderately sloping Rhoades soils have a thin surface layer and a dense, sodic subsoil. They are in swales and adjacent to drainageways.

This soil association is used mainly as rangeland. In places the gently sloping soils, particularly those adjacent to streams, are used for growing small grain and legumes. Sparse stands of native trees and shrubs are along some drainageways. They provide food for wildlife and cover for wildlife and livestock. Rooting depth is limited by the soft bedrock. The hazards of water erosion and soil blowing are high. Droughtiness,

high runoff, and low available water capacity are the main limitations to agricultural use.

This association is suited to sites for buildings, is poorly suited to septic tank absorption fields and cultivated crops, and is well suited to rangeland.

3. Cabba-Brandenburg-Rhoades association

Well drained, excessively drained, and moderately well drained, shallow and deep, medium textured soils which formed in material weathered from siltstone or porcelanite or which formed in alluvium

This association consists of hilly upland, narrow side slopes, and broad foot slopes adjacent to drainageways. Most areas of this unit are drained by well defined, intermittent streams. Slope ranges from 1 to 50 percent.

This association makes up about 2 percent of the county. It is about 25 percent Cabba and similar soils, 25 percent Brandenburg and similar soils, and 20 percent Rhoades and similar soils. The remaining 30 percent is minor soils.

The strongly sloping to very steep Cabba soils are on ridges and hills. They have a surface layer and substratum of silt loam. Soft siltstone bedrock is at a depth of about 18 inches.

The moderately sloping to very steep Brandenburg soils are on cone-shaped hills and ridges. They have a surface layer of loam and a substratum of very channery loam. Shattered porcelanite is at a depth of about 10 inches.

The nearly level to strongly sloping Rhoades soils are on side slopes and foot slopes. They are below the Cabba and Brandenburg soils. They have a surface layer of silt loam, a subsoil of silty clay loam, and a substratum of silty clay and clay.

The most extensive minor soils in this association are the Amor, Morton, and Straw soils. The gently sloping and moderately sloping Amor and Morton soils are medium textured. The Amor soils are on foot slopes and side slopes. The Morton soils are on side slopes. The nearly level Straw soils are medium textured. They are on narrow flood plains.

This association is used mainly as rangeland. In places the gently sloping soils are used for growing legumes, small grain, and grass for hay. Sparse stands of native trees and shrubs are along some drainageways. They provide food for wildlife and cover for wildlife and livestock. Rooting depth is limited by the bedrock. The hazard of water erosion is high. Droughtiness, high runoff, low available moisture capacity, and the presence of sodium salts are the main limitations to agricultural use.

This association is suited to sites for buildings, is poorly suited to septic tank absorption fields and cultivated crops, and is well suited to rangeland.

4. Cabba-Badland-Cherry association

Well drained, shallow and deep, medium textured and moderately fine textured soils which formed in material weathered from siltstone or which formed in alluvium; and badland

This association consists of side slopes, cliffs, buttes, fans, and foot slopes. It is in the valleys along the major rivers (fig. 3). Most areas of this association are dissected by well defined streams and drainageways. Slope ranges from 1 to 120 percent.

This association makes up about 15 percent of the county. It is about 35 percent Cabba and similar soils, 20 percent Badland, and 10 percent Cherry and similar soils. The remaining 35 percent is minor soils.

The moderately sloping to very steep Cabba soils are on ridges and hills. They have a surface layer of loam and a substratum of silt loam. Soft bedrock is at a depth of about 18 inches.

The miscellaneous area of Badland typically is south-facing slopes. The steep and very steep Badland consists of barren, eroding, soft bedrock.

The nearly level to strongly sloping Cherry soils are on side slopes, foot slopes, and fans. They are below the Cabba soils and Badland. They have a surface layer and subsoil of silty clay loam and a substratum of silty clay loam, silty clay, and silt loam.

The most extensive minor soils in this association are the Arikara, Arnegard, Havrelon, and Vanda soils. The strongly sloping to very steep Arikara soils are on north- and east-facing side slopes. The Arnegard soils are in swales and are medium textured. The nearly level and gently sloping Havrelon soils are on flood plains and fans. They are medium textured. The nearly level to moderately sloping Vanda soils are on fans. They are fine textured.

This soil association is used mainly as rangeland. In places the gently sloping Cherry soils are used to grow grasses and legumes for pasture or hay. The minor Arikara soils support stands of trees and shrubs that provide food for wildlife and cover for wildlife and livestock. Rooting depth is limited by the depth to bedrock. The hazard of water erosion is high. Slope, droughtiness, high runoff, and low available water capacity are the main limitations to agricultural use.

This association is poorly suited to sites for buildings, septic tank absorption fields, and cultivated crops and is suited to rangeland.

Dominantly moderately deep, nearly level to steep soils on uplands

The soil associations in this group consist of soils which formed in material weathered from siltstone and

shale or which formed in alluvium. The four associations in this group make up about 29 percent of the county. They are well suited to rangeland, are suited to sites for buildings and cultivated crops, and are poorly suited to septic tank absorption fields.

5. Morton-Rhoades-Savage association

Well drained and moderately well drained, moderately deep and deep, medium textured and moderately fine textured soils which formed in material weathered from shale and siltstone or which formed in alluvium

This association consists of a gently rolling upland, broad side slopes and foot slopes, and narrow swales. Most areas of this unit are drained by shallow, intermittent streams. Slope ranges from 1 to 15 percent.

This association makes up about 23 percent of the county. It is about 35 percent Morton and similar soils, 15 percent Rhoades and similar soils, and 10 percent Savage and similar soils (fig. 4). The remaining 40 percent is minor soils.

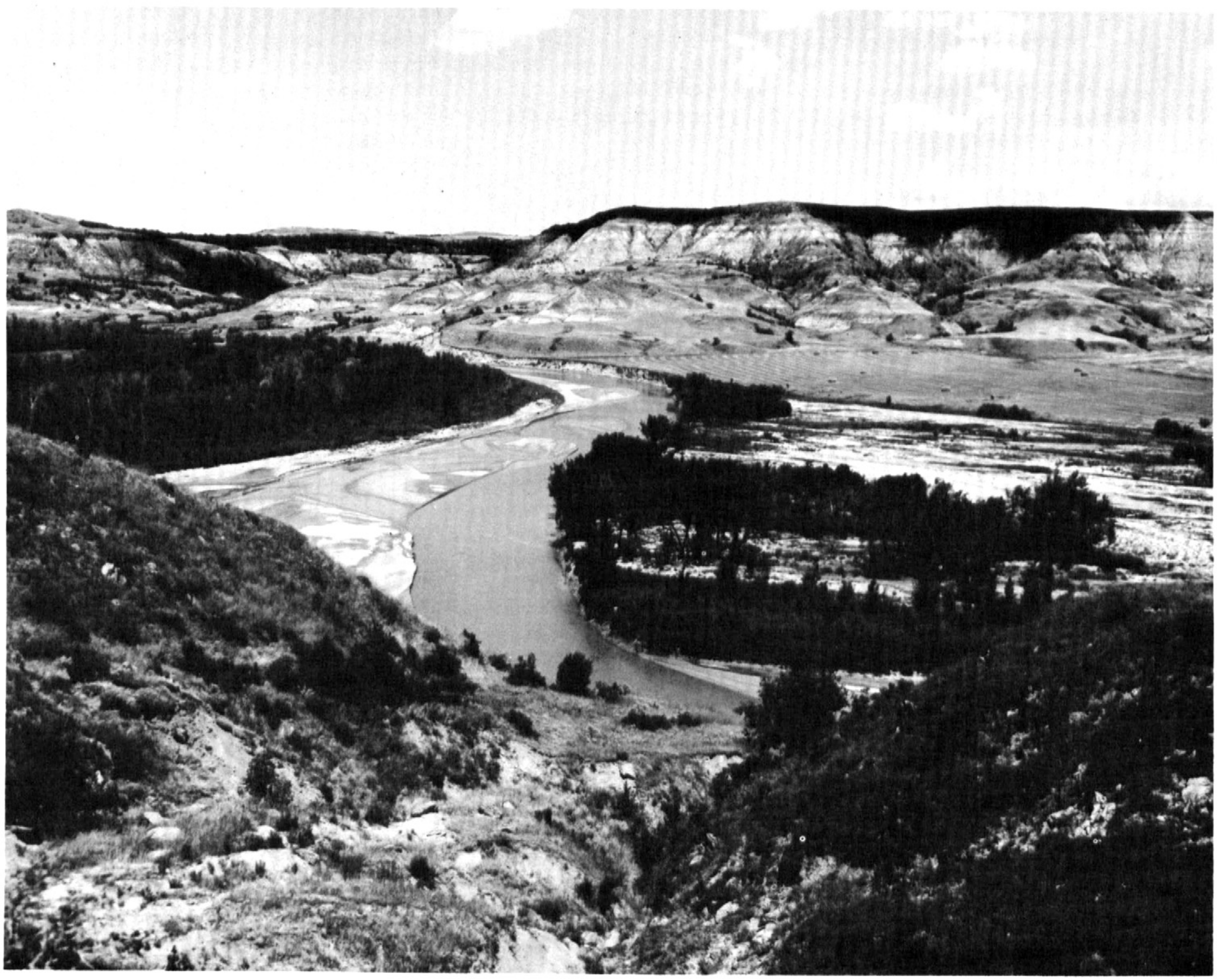


Figure 3.—The Little Missouri River and North Dakota Badlands. The soils on the flood plain are the Havrelon and Banks soils and the Trembles Variant; the soils on the foot slopes are the Cherry and Vanda soils; and the soils on the side slopes are the Cabba, Cherry, and Arikara soils and the miscellaneous area of Badland.

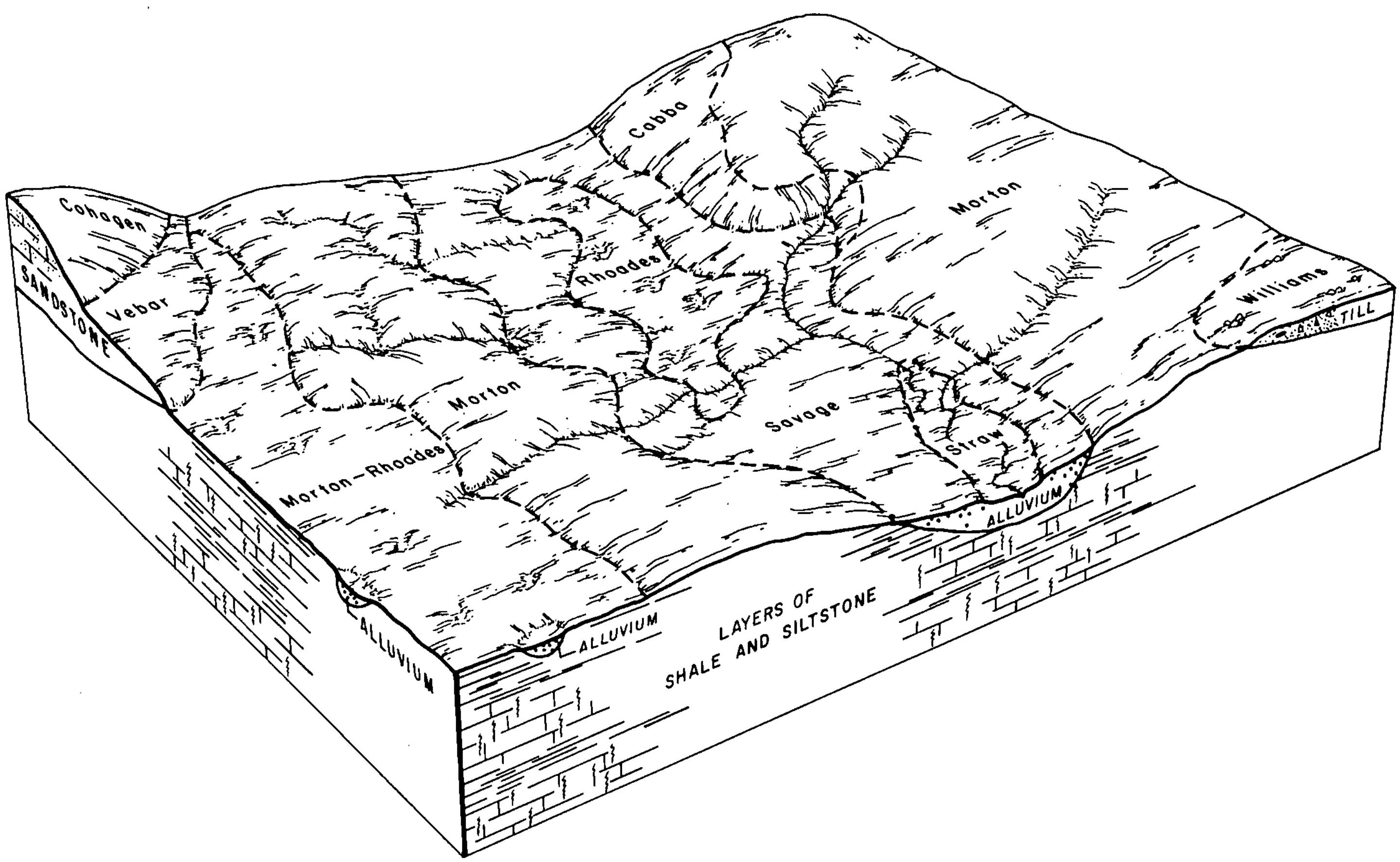


Figure 4.—Typical pattern of soils and underlying material in the Morton-Rhoades-Savage association.

The nearly level to moderately sloping Morton soils are on convex side slopes. They have a surface layer, subsoil, and substratum of silt loam. Soft bedrock is at a depth of about 37 inches.

The nearly level to strongly sloping Rhoades soils are on slightly concave side slopes and in swales. They have a surface layer of silt loam, a subsoil of silty clay loam, and a substratum of silty clay and clay.

The nearly level and gently sloping Savage soils are on foot slopes and in swales. They have a surface layer of silty clay loam and a subsoil and substratum of silty clay.

The most extensive minor soils in this association are the Cabba, Cohagen, Straw, Vebar, and Williams soils. The strongly sloping to very steep Cabba and Cohagen soils are on hills and ridges. Cabba soils are medium textured, and Cohagen soils are moderately coarse textured. The nearly level Straw soils are on flood plains. The strongly sloping to moderately steep Vebar soils are on side slopes. They are moderately coarse textured. The nearly level to moderately sloping Williams soils are on broad hilltops. They are medium textured.

This association is used about equally as rangeland or for crops. The soils that have a dense, sodic subsoil and the more sloping soils are used as rangeland. The less sloping soils are used for crops. Sparse stands of native trees and shrubs are along many drainageways. They provide food for wildlife and cover for wildlife and livestock. The moderate available water capacity and presence of sodium salts are the main limitations to agricultural use.

This association is suited to sites for buildings and cultivated crops, is well suited to rangeland, and is poorly suited to septic tank absorption fields.

6. Regent-Morton-Savage association

Well drained, moderately deep and deep, moderately fine textured and medium textured soils which formed in material weathered from shale and siltstone or which formed in alluvium

This association consists of undulating upland, broad side slopes, and narrow swales. Most areas of this unit are drained by shallow, intermittent streams. Slope ranges from 1 to 9 percent.

This association makes up about 2 percent of the county. It is about 35 percent Regent and similar soils, 15 percent Morton and similar soils, and 15 percent

Savage and similar soils. The remaining 35 percent is minor soils.

The nearly level to moderately sloping Regent soils are in the middle part of side slopes. They have a surface layer of silty clay loam, a subsoil of silty clay, and a substratum of silty clay loam. Soft shale bedrock is at a depth of about 33 inches.

The nearly level to moderately sloping Morton soils are on the upper part of side slopes. They have a surface layer, subsoil, and substratum of silt loam. Soft siltstone bedrock is at a depth of about 37 inches.

The nearly level and gently sloping Savage soils are on the lower part of side slopes and in swales. They have a surface layer of silty clay loam and a subsoil and substratum of silty clay. In some places the surface layer is silty clay. In other places the surface layer and subsoil are dark colored to a depth of 16 to 26 inches.

The most extensive minor soils in this association are the Bowdle, Cabba, Cohagen, Lefor, Rhoades, and Straw soils. The nearly level and gently sloping Bowdle soils are on terraces. The moderately sloping to steep Cabba soils are on hills and ridges. The moderately sloping to very steep Cohagen soils are on hills and ridges. They are moderately coarse textured. The nearly level to moderately sloping Lefor soils are moderately coarse textured. They are on side slopes. The nearly level to strongly sloping Rhoades soils are medium textured. They are in swales and on side slopes. The nearly level Straw soils are on flood plains.

This soil association is used mainly for crops. Sparse stands of native trees and shrubs are along many drainageways. They provide food and cover for wildlife. The hazard of water erosion is moderate. The moderately fine textured surface layer of the Regent and Savage soils and the moderate available water capacity are the main limitations to agricultural use.

This association is well suited to cultivated crops, sites for buildings, and rangeland and is poorly suited to septic tank absorption fields.

7. Sen-Chama-Cabba association

Well drained, moderately deep and shallow, medium textured soils that formed in material weathered from siltstone

This association consists of gently rolling, dissected uplands. Most areas are drained by defined, intermittent streams. Slope ranges from 1 to 15 percent.

This association makes up about 2 percent of the county. It is about 30 percent Sen and similar soils, 25 percent Chama and similar soils, and 15 percent Cabba and similar soils. The remaining 30 percent is minor soils.

The gently sloping and moderately sloping Sen soils are on the lower part of side slopes and on foot slopes. They have a surface layer, subsoil, and substratum of silt loam. Soft siltstone bedrock is at a depth of about 34 inches.

The moderately sloping Chama soils are on the upper part of side slopes. They have a surface layer, subsoil, and substratum of silt loam. Soft siltstone bedrock is at a depth of about 30 inches.

The moderately sloping to steep Cabba soils are on ridges and hills. They have a surface layer and substratum of silt loam. Soft siltstone bedrock is at a depth of about 18 inches.

The most extensive minor soils in the association are the Belfield, Grail, Regent, and Rhoades soils. The nearly level and gently sloping Belfield soils are deep and are in swales. The nearly level and gently sloping Grail soils have a surface layer of silty clay loam. They are in swales. The nearly level to moderately sloping Regent soils are moderately deep and have a surface layer of silty clay loam. They are on the middle part of side slopes. The nearly level to moderately sloping Rhoades soils have a surface layer of silt loam and a dense, sodic subsoil. They are in swales and on foot slopes.

This association is used mainly for crops. The more sloping soils are used as rangeland. Sparse stands of native trees and shrubs are along a few drainageways. They provide food for wildlife and cover for wildlife and livestock. Rooting depth is limited by the soft bedrock. The hazard of water erosion is high. Moderate to low available water capacity and droughtiness are the main limitations to agricultural use.

This association is suited to sites for buildings and cultivated crops, is well suited to rangeland, and is poorly suited to septic tank absorption fields.

8. Moreau-Rhoades association

Well drained and moderately well drained, moderately deep and deep, fine textured and medium textured soils which formed in material weathered from shale or which formed in alluvium

This association consists of a gently rolling and rolling, dissected upland. Most areas are drained by well defined, intermittent streams. Slope ranges from 1 to 15 percent.

This association makes up about 2 percent of the county. It is about 40 percent Moreau soils and 20 percent Rhoades and similar soils. The remaining 40 percent is minor soils.

The nearly level to moderately sloping Moreau soils are on side slopes and foot slopes. They have a surface layer, subsoil, and substratum of silty clay. Soft shale bedrock is at a depth of about 32 inches.

The nearly level to strongly sloping Rhoades soils are on foot slopes and in swales. They have a surface layer of silt loam, a subsoil of silty clay loam, and a substratum of silty clay and clay.

The most extensive minor soils in this association are

the Brandenburg, Cabba, Morton, Regent, Savage, and Vebar soils. The moderately sloping to very steep Brandenburg soils have shattered porcelanite at a depth of about 10 inches. The gently sloping to very steep Cabba soils have soft siltstone at a depth of about 18 inches. The Brandenburg and Cabba soils are on ridges and hills. The nearly level to moderately sloping Morton and Regent soils have soft bedrock at a depth of 37 and 33 inches, respectively. Morton soils are on the upper part of side slopes, and Regent soils are on the middle part of side slopes. The Morton soils have a surface layer of silt loam. The nearly level and gently sloping Savage soils are deep and have a surface layer of silty clay loam. They are on foot slopes and in swales. The nearly level to moderately steep Vebar soils have a surface layer of fine sandy loam and have soft sandstone bedrock at a depth of about 38 inches. They are on side slopes.

This association is used mainly for crops; however, a significant part is rangeland. The rangeland usually consists of the more sloping soils and areas that are dominantly Rhoades soils. Sparse stands of native trees and shrubs are along some drainageways. They provide food for wildlife and cover for wildlife and livestock. Rooting depth is limited by the soft bedrock and the dense, sodic subsoil. The hazards of soil blowing and water erosion are high. Moderate available water capacity, runoff, and the presence of sodium salts are the main limitations to agricultural use.

This association is well suited to rangeland, is suited to cultivated crops and sites for buildings, and is poorly suited to septic tank absorption fields.

Dominantly moderately deep, nearly level to strongly sloping soils on uplands and terraces

The Vebar-Parshall association consists of soils which formed in material weathered from soft sandstone or which formed in alluvium (fig. 5). The association in this group makes up about 11 percent of the county. It is suited to cultivated crops and sites for buildings, is poorly suited to septic tank absorption fields, and is well suited to rangeland.

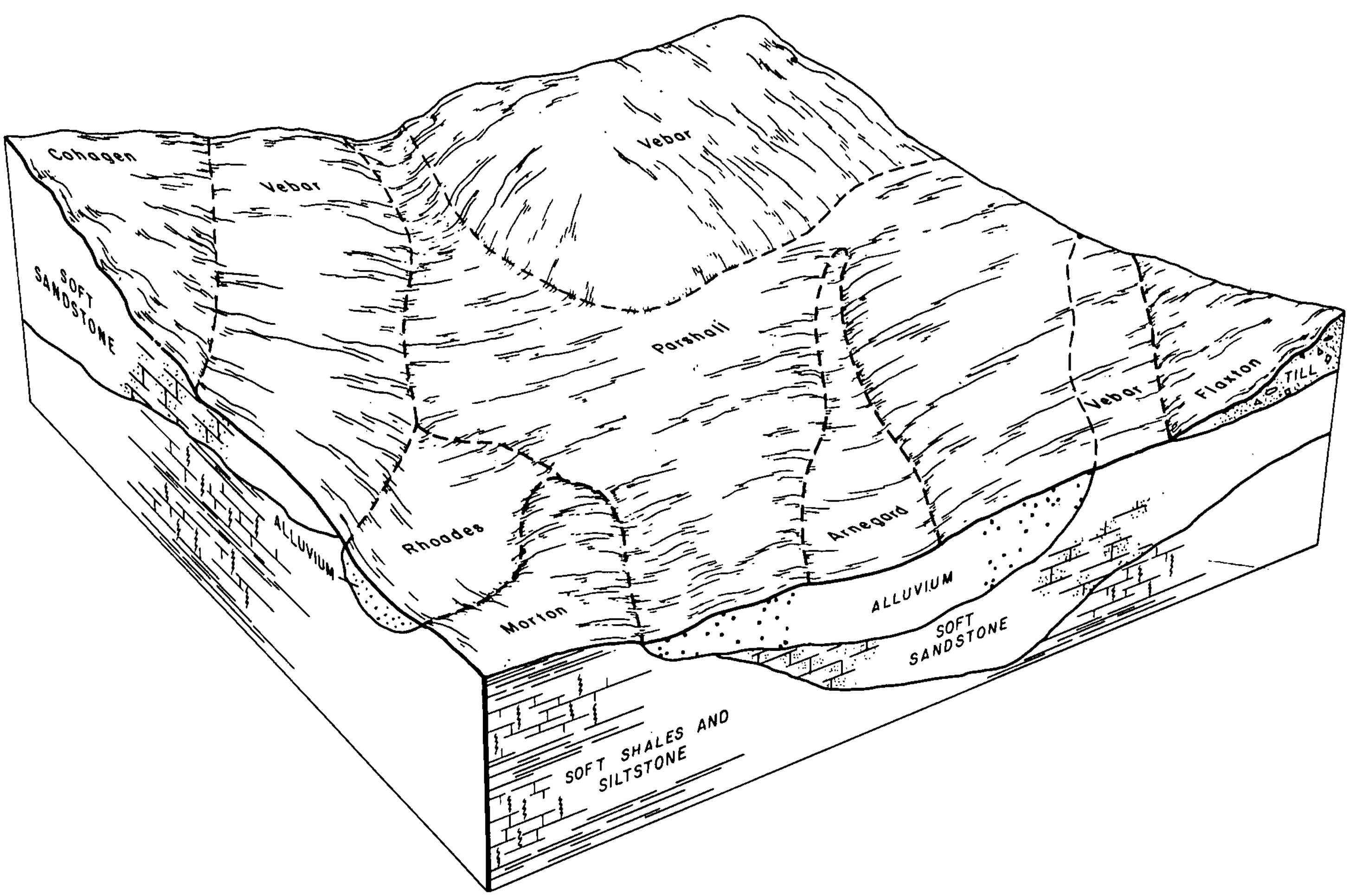


Figure 5.—Typical pattern of soils and underlying material in the Vebar-Parshall association.

9. Vebar-Parshall association

Well drained, moderately deep and deep, moderately coarse textured soils which formed in material weathered from sandstone or which formed in alluvium

This association consists of undulating and gently rolling, dissected uplands, narrow terraces, and broad swales. Most areas of this unit are drained by moderately entrenched, intermittent streams. Slope ranges from 1 to 15 percent.

This association makes up about 11 percent of the county. It is about 35 percent Vebar soils and 30 percent Parshall and similar soils. The remaining 35 percent is minor soils.

The nearly level to strongly sloping Vebar soils are on side slopes and foot slopes. They have a surface layer, subsoil, and substratum of fine sandy loam. Soft sandstone bedrock is at a depth of about 38 inches.

The nearly level to moderately sloping Parshall soils are on foot slopes and terraces and in swales. They have a surface layer, subsoil, and substratum of fine sandy loam. Soft bedrock is at a depth of more than 60 inches.

The most extensive minor soils in this association are the Amor, Arnegard, Cohagen, Flaxton, Harriet, Lefor, Morton, and Rhoades soils. The gently sloping to strongly sloping Amor soils have a surface layer of loam. They are on side slopes. The nearly level and gently sloping Arnegard soils also have a surface layer of loam. They are in swales. The strongly sloping to very steep Cohagen soils have soft sandstone bedrock at a depth of about 15 inches. They are on hills and ridges. The nearly level to moderately sloping Flaxton soils have a substratum of clay loam. The level Harriet soils are poorly drained and have a surface layer of silt loam. They are on flood plains. The nearly level to moderately sloping Lefor soils have a surface layer of fine sandy loam and a subsoil of sandy clay loam. They are on side slopes and foot slopes. The nearly level to moderately sloping Morton soils have a surface layer of silt loam. They are on side slopes. The nearly level to strongly sloping Rhoades soils have a surface layer of silt loam and a subsoil of silty clay loam. They are in swales and on foot slopes.

This soil association is used mainly for crops. The more sloping soils and the soils that have a dense, sodic subsoil are generally rangeland. Rooting depth is limited by the soft bedrock. The hazard of soil blowing is high, and the hazard of water erosion is moderate. The hazard of soil blowing, moderate available water capacity, and related droughtiness are the main limitations to agricultural use.

This association is suited to cultivated crops and sites for buildings and is well suited to rangeland. The soils in this association are poorly suited to septic tank absorption fields, except for the Parshall soil, which is well suited to septic tank absorption fields.

Dominantly deep, nearly level to very steep soils on terraces, uplands, and fans

The soil associations in this group consist of soils which formed in alluvium, glacial till, and clayey sediment and which formed in material weathered from sandstone, siltstone, and shale. The three associations in this group make up about 14 percent of the county. They are well suited to rangeland, are poorly suited to septic tank absorption fields, and are suited to sites for buildings. These soils are suited to cultivated crops, except for the Baahish-Lakoa-Hidatsa association, which is poorly suited to crops.

10. Savage-Lawther-Rhoades association

Well drained and moderately well drained, deep, medium to fine textured soils that formed in alluvium and clayey sediment

This association consists of an undulating upland and broad foot slopes and swales. Most areas of this unit are drained by well defined, intermittent streams. Slope ranges from 1 to 6 percent.

This association makes up about 3 percent of the county. It is about 35 percent Savage and similar soils, 15 percent Lawther soils, and 10 percent Rhoades and similar soils. The remaining 40 percent is minor soils.

The nearly level and gently sloping Savage soils are on the lower part of side slopes and foot slopes and in swales. They have a surface layer of silty clay loam and a subsoil and substratum of silty clay.

The nearly level and gently sloping Lawther soils are in the center of swales. They have a surface layer and subsoil of silty clay and a substratum of silty clay and silty clay loam.

The nearly level and gently sloping Rhoades soils are in slight depressions and along drainageways. They have a surface layer of silt loam, a subsoil of silty clay loam, and a substratum of silty clay and clay.

The most extensive minor soils in this association are the Bowdle, Chama, Grail, Parshall, Shambo, and Straw soils. The nearly level and gently sloping Bowdle soils have a surface layer of loam. They are on terraces. The moderately sloping Chama soils have soft bedrock at a depth of about 30 inches. They are on side slopes. The nearly level Grail soils have a thick surface layer of silt loam. They are in swales. The nearly level to moderately sloping Parshall soils have a surface layer of fine sandy loam. They are in swales and on terraces. The nearly level and gently sloping Shambo soils have a surface layer of loam. They are on fans and terraces. The nearly level Straw soils have a surface layer of loam or silt loam. They are on flood plains and are subject to flooding.

This association is used mainly for crops. The Rhoades soils in the association are generally used as rangeland. Sparse stands of native trees and shrubs are

along many drainageways. They provide food for wildlife and cover for wildlife and livestock. The hazard of water erosion is high, and the hazard of soil blowing is slight. The presence of sodium salts, fine and moderately fine textured surface layers, and the hazard of erosion are the main limitations to agricultural use.

This association is suited to cultivated crops and rangeland and is poorly suited to sites for buildings and to septic tank absorption fields.

11. Williams-Amor-Arnegard association

Well drained, deep and moderately deep, medium textured soils which formed in glacial till or alluvium or which formed in material weathered from sandstone and siltstone

This association consists of gently rolling and rolling, glaciated uplands. Most areas of this unit are drained by well defined, intermittent streams. Slope ranges from 1 to 15 percent.

This association makes up about 6 percent of the county. It is about 45 percent Williams and similar soils, 20 percent Amor and similar soils, and 10 percent Arnegard soils. The remaining 25 percent is minor soils (fig. 6).

The nearly level to strongly sloping Williams soils are on hilltops and side slopes. They have a surface layer of loam and a subsoil and substratum of clay loam.

The gently sloping to strongly sloping Amor soils are on side slopes. They have a surface layer, subsoil, and substratum of loam. Soft bedrock is at a depth of about 34 inches.

The nearly level and gently sloping Arnegard soils are in swales. They have a surface layer and subsoil of loam and a substratum of loam and very fine sandy loam.

The most extensive minor soils in this association are the Cabba, Dimmick, Noonan, Rhoades, Tonka, Vebar, and Zahl soils. The gently sloping to very steep Cabba soils have soft bedrock at a depth of about 18 inches. They are on ridges and hills. The level Dimmick soils have a surface layer of clay. They are in depressions. The gently sloping and moderately sloping Noonan soils have a dense, sodic subsoil. They are in slight depressions. The nearly level to strongly sloping Rhoades soils have a thin surface layer of silt loam and a subsoil of sodic silty clay loam. They are in swales and on foot slopes. The level Tonka soils are in depressions. The nearly level to moderately steep Vebar soils have

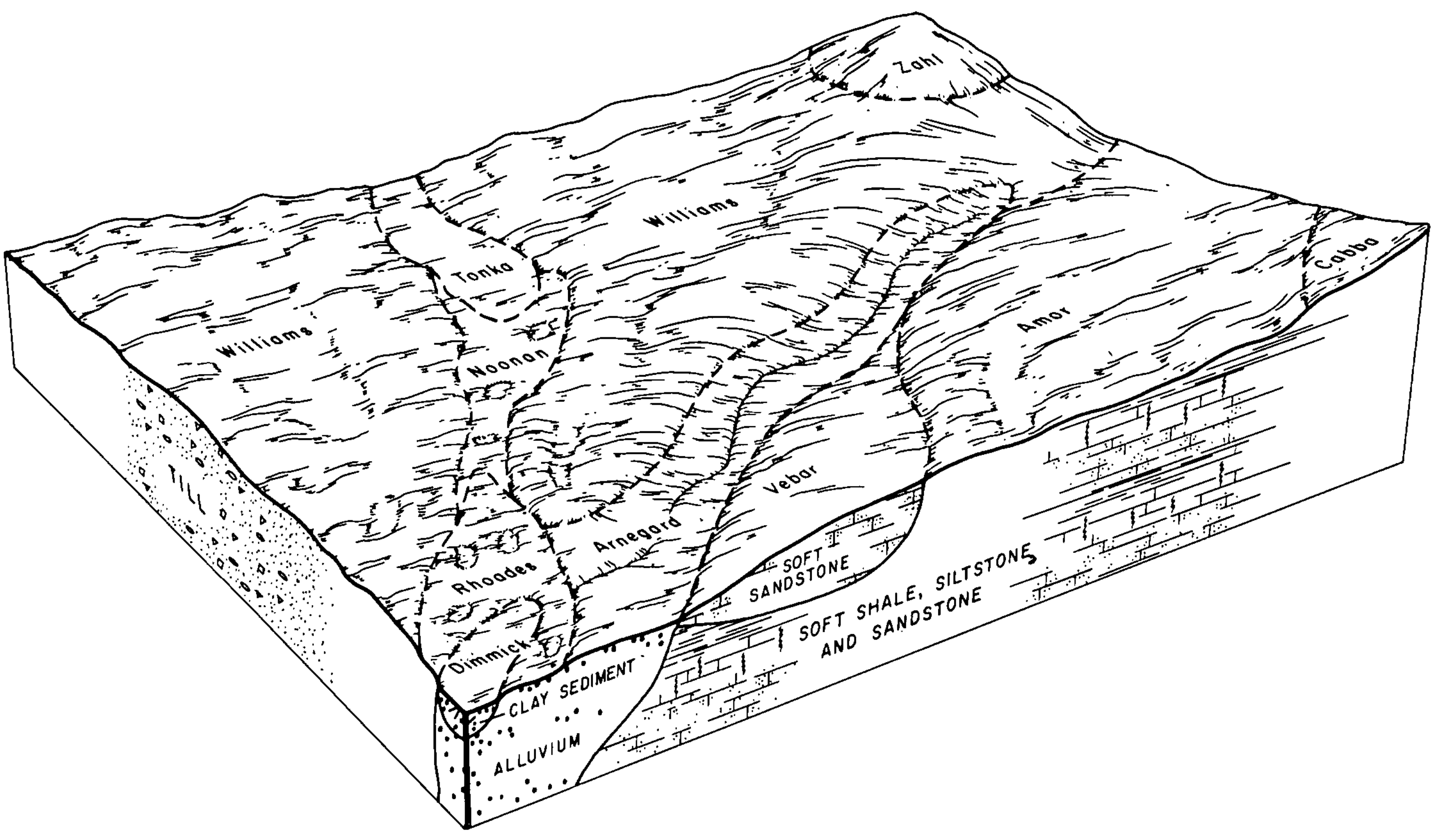


Figure 6.—Typical pattern of soils and underlying material in the Williams-Amor-Arnegard association.

soft sandstone bedrock at a depth of about 38 inches. They are on side slopes. The moderately sloping to moderately steep Zahl soils are on knobs.

This association is used mainly for crops. The more sloping soils and the soils in depressions are in rangeland or in wetland wildlife habitat. The hazard of water erosion is moderate, and the hazard of soil blowing is slight. Water erosion is the main limitation to agricultural use.

This association is suited to sites for buildings and to septic tank absorption fields and is well suited to cultivated crops and rangeland.

12. Baahish-Lakoa-Hidatsa association

Somewhat excessively drained and well drained, deep, moderately coarse textured and medium textured soils which formed in alluvium over gravelly outwash or which formed in material weathered from sandstone and shale

This association consists of hilly and steep uplands and associated pediments and fans. Most areas of this unit are drained by well defined drainageways and intermittent streams. Slope ranges from 1 to 50 percent.

This association makes up about 3 percent of the county. It is about 25 percent Baahish soils, 20 percent Lakoa soils, and 20 percent Hidatsa and similar soils (fig. 7). The remaining 35 percent is minor soils.

The strongly sloping to very steep Baahish soils are on side slopes. They have a surface layer of fine sandy loam, a subsoil of sandy loam and fine sandy loam, and a substratum of very gravelly fine sandy loam and very gravelly loam.

The moderately steep to very steep Lakoa soils are on the lower part of side slopes. They have a thin organic

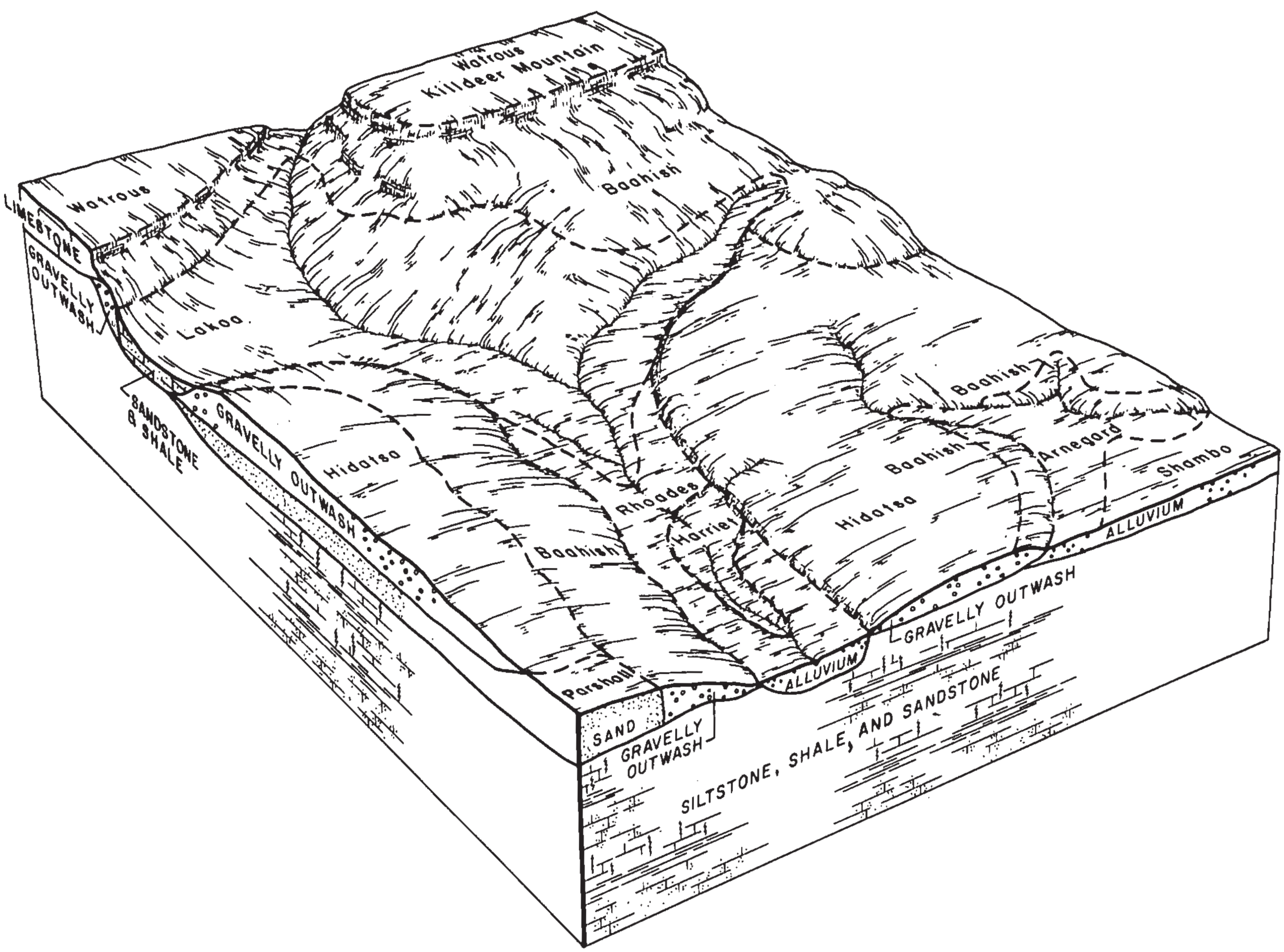


Figure 7.—Typical pattern of soils and underlying material in the Baahish-Lakoa-Hidatsa association.

cover, a surface layer of loam, a subsoil of clay loam, and a substratum of loam.

The nearly level and gently sloping Hidatsa soils are on fans and terraces. They have a surface layer of loam and a subsoil of very gravelly sandy loam.

The most extensive minor soils in this association are the Arnegard, Cohagen, Harriet, Parshall, Rhoades, Shambo, and Watrous soils. Also included are areas of rock outcrop. The nearly level and gently sloping Arnegard soils are in swales. The strongly sloping to very steep Cohagen soils have soft bedrock at a depth of about 15 inches. They are on ridges and hills. The level Harriet soils are on flood plains. The nearly level to moderately sloping Parshall soils have a surface layer, subsoil, and substratum of fine sandy loam. They are in swales. The nearly level to strongly sloping Rhoades soils have a thin surface layer of silt loam and a dense, sodic subsoil. They are in swales and on foot slopes. The nearly level and gently sloping Shambo soils have a surface layer of loam and a subsoil and substratum of loam and silt loam. They are on fans and terraces. The nearly level and gently sloping Watrous soils have hard sandstone bedrock at a depth of about 27 inches. They are on hills.

The soils in this association are used mainly as rangeland and for wildlife habitat, except for the Hidatsa soils, which are mostly used for crops. A dense stand of native trees and shrubs on the Lakoa soils provides food and cover for wildlife. The hazard of water erosion is high. Erosion hazard, slope, and droughtiness are the main limitations to agricultural use.

This association is poorly suited to cultivated crops, septic tank absorption fields, and sites for buildings but is suited to rangeland.

13. Williams-Cabba-Zahl association

Well drained, deep and shallow, medium textured soils that formed in glacial till and in material weathered from siltstone

This association consists of hilly, dissected glaciated uplands. Most areas of this unit are drained by well defined, intermittent drainageways. Slope ranges from 3 to 45 percent.

This association makes up about 2 percent of the county. It is about 45 percent Williams and similar soils, 10 percent Cabba and similar soils, and 10 percent Zahl and similar soils. The remaining 35 percent is minor soils.

The gently sloping to moderately steep Williams soils are on side slopes and broad hilltops. They have a surface layer of loam and a subsoil and substratum of clay loam.

The gently sloping to very steep Cabba soils are on hills and ridges. They have a surface layer of loam and a substratum of silt loam. Soft bedrock is at a depth of about 18 inches.

The moderately sloping to moderately steep Zahl soils are on knobs and hills. They have a surface layer of loam and a substratum of clay loam.

The most extensive minor soils in the association are the Amor, Bowdle, Rhoades, Straw, and Vebar soils. The nearly level to strongly sloping Amor soils have soft siltstone bedrock at a depth of about 34 inches. They are on side slopes. The nearly level and gently sloping Bowdle soils have a substratum of very gravelly sand. They are on terraces. The nearly level to strongly sloping Rhoades soils have a surface layer of silt loam and a dense, sodic subsoil. They are on foot slopes and in swales. The nearly level Straw soils are on narrow flood plains. The nearly level to strongly sloping Vebar soils have a surface layer, subsoil, and substratum of fine sandy loam. They are on side slopes.

This association is used mainly as rangeland. In places the lesser sloping soils are used for cultivated crops and hay. Sparse stands of native trees and shrubs are along some drainageways. They provide food for wildlife and cover for wildlife and livestock. The hazard of water erosion is high. Slope, low available water capacity and the resultant droughtiness, and runoff are the main limitations to agricultural use.

This association is poorly suited to cultivated crops, sites for buildings, and septic tank absorption fields but is well suited to rangeland.

Dominantly deep, level to gently sloping soils on terraces, flood plains, fans, and uplands

The soil associations in this group consist of soils that formed in alluvium and clayey sediment. The three associations in this group make up about 6 percent of the county. They are suited to cultivated crops, are well suited to rangeland, and are poorly suited to sites for buildings and to septic tank absorption fields.

14. Straw-Velva association

Well drained, deep, medium textured and moderately coarse textured soils that formed in alluvium

This association consists of nearly level flood plains and low terraces along major streams. Most areas are crossed by shallow, intermittent drainageways that are perpendicular to the streams. Slope ranges from 0 to 3 percent.

This association makes up about 3 percent of the county. It is about 70 percent Straw soils and 10 percent Velva soils (fig. 8). The remaining 20 percent is minor soils.

The level Straw soils have a surface layer of loam and silt loam and a substratum of loam.

The nearly level Velva soils are on the natural levee of streams. They have a surface layer of fine sandy loam and a substratum of stratified loamy fine sand, fine sandy loam, loamy sand, and loam.

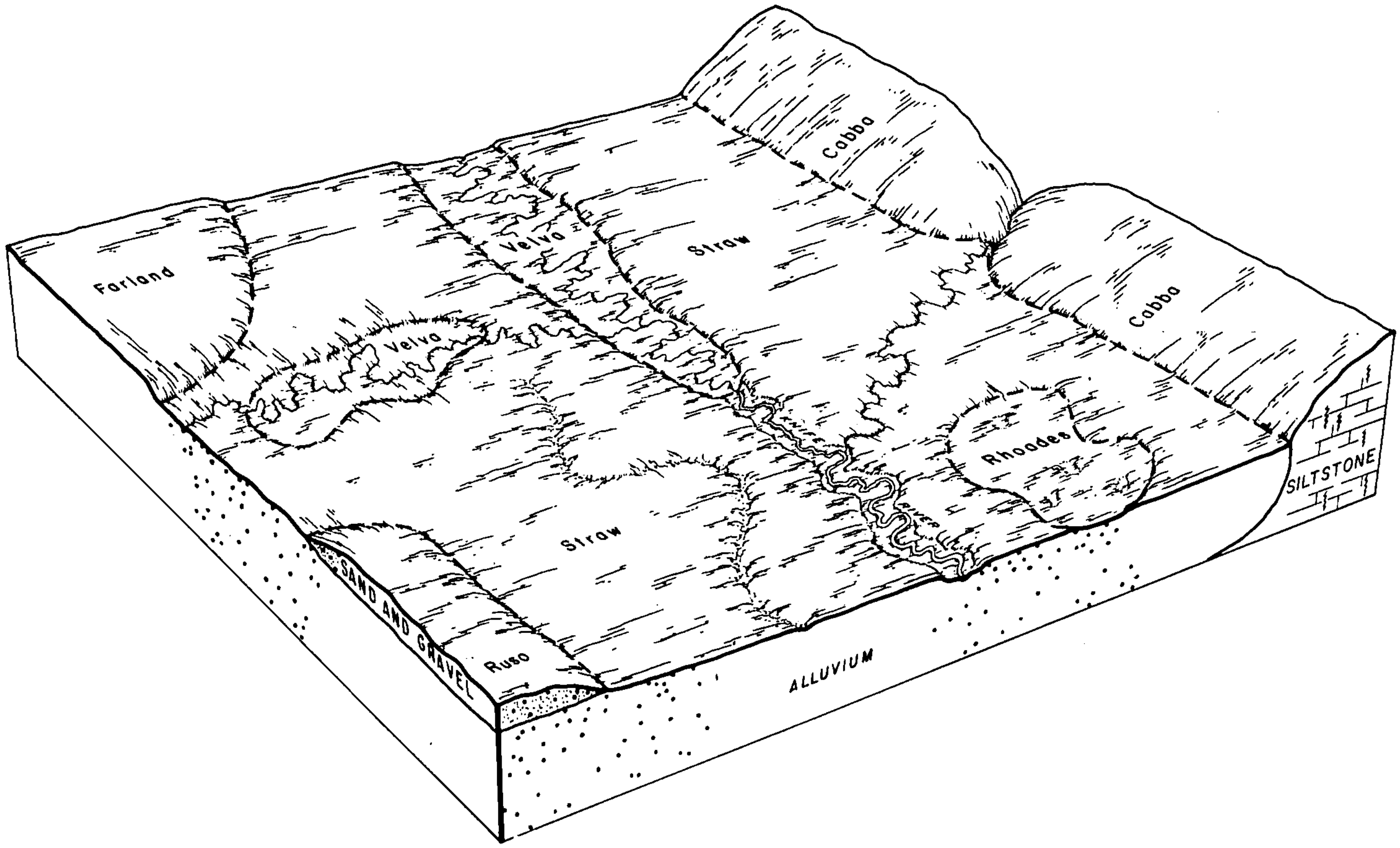


Figure 8.—Typical pattern of soils and underlying material in the Straw-Velva association.

The most extensive minor soils in the association are the Cabba, Farland, Rhoades, and Ruso soils. The gently sloping to very steep Cabba soils are on ridges and hills adjacent to the Straw soils. They have soft bedrock at a depth of about 18 inches. The nearly level and gently sloping Farland soils have a surface layer of silt loam. The nearly level Ruso soils have a surface layer of sandy loam. The Farland and Ruso soils are on terraces. The Rhoades soils have a surface layer of loam or silt loam and a dense, sodic subsoil. They are in swales and on foot slopes.

This association is used mainly for crops or for hay and pasture. Most areas have a sparse to dense stand of native trees and shrubs along the stream channels. These trees and shrubs provide food and cover for wildlife. Flooding and soil blowing are the main limitations to agricultural use.

This association is well suited to cultivated crops and rangeland but is poorly suited to sites for buildings and to septic tank absorption fields.

15. Havrelon-Banks-Trembles Variant association

Well drained, somewhat excessively drained, and poorly drained, deep, medium textured, coarse textured, and moderately coarse textured soils that formed in alluvium

This association consists of nearly level and gently sloping flood plains. Most areas of this unit are crossed by shallow drainageways that originate in the adjacent uplands. Slope ranges from 0 to 6 percent.

This association makes up about 1 percent of the county. It is about 30 percent Havrelon and similar soils, 15 percent Banks and similar soils, and 15 percent Trembles Variant and similar soils. The remaining 40 percent is minor soils.

The nearly level and gently sloping Havrelon soils have a surface layer and substratum of silt loam.

The nearly level Banks soils are on the natural levee along the stream channel. They have a surface layer of loamy sand and a substratum of fine sand and sand.

The level Trembles Variant has a surface layer and substratum of fine sandy loam.

The most extensive minor soils in this association are the Cherry and Vanda soils. The Cherry and Vanda soils are on foot slopes. The Cherry soils have a surface layer of silty clay loam and the Vanda soils have a surface layer of silty clay.

This soil association is used mainly as rangeland or for pasture. Dense stands of native trees and shrubs are present in many places. They provide food for wildlife and cover for wildlife and livestock. The hazard of soil blowing is high. Flooding, the low available water capacity of the Banks soils, and the wetness of the Trembles Variant are the main limitations to agricultural use.

This association is poorly suited to sites for buildings and to septic tank absorption fields, is suited to cultivated crops, and is well suited to rangeland and pasture.

16. Rhoades-Harriet-Dimmick association

Moderately well drained, poorly drained, and very poorly drained, deep, medium textured and fine textured soils that formed in alluvium and clayey sediment

This association consists of level to gently sloping flood plains and terraces or upland depressions. Most areas of this unit are drained by shallow, intermittent streams. Slope ranges from 0 to 6 percent.

This association makes up about 2 percent of the county. It is about 40 percent Rhoades and similar soils, 15 percent Harriet and similar soils, and 15 percent Dimmick and similar soils. The remaining 30 percent is minor soils.

The nearly level and gently sloping, moderately well drained Rhoades soils are on foot slopes of uplands. They have a surface layer of silt loam, a subsoil of silty clay loam, and a substratum of silty clay and clay.

The level, poorly drained Harriet soils are on flood plains. They have a surface layer of silt loam, a subsoil of silty clay loam, and a substratum of silty clay loam, silty clay, and sandy clay loam.

The level, very poorly drained Dimmick soils are in depressions and oxbows. They have a surface layer and substratum of clay.

The most extensive minor soils in this association are the Cabba, Farland, and Straw soils. Cabba soils are on hills and knobs along the flood plain. They have soft bedrock at a depth of about 18 inches. The well drained Farland soils have a surface layer of silt loam and a subsoil of silty clay loam. They are on terraces. The well drained Straw soils have a surface layer of silt loam or loam.

This association is used mainly as rangeland. The hazards of water erosion and soil blowing are low. The presence of sodium salts, restricted rooting depth, wetness, and flooding are the main limitations to agricultural use.

This association is poorly suited to sites for buildings, to septic tank absorption fields, and to cultivated crops and is suited to rangeland.

detailed soil map units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and management of the soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil, and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Morton silt loam, 1 to 3 percent slopes, is one of several phases in the Morton series.

Some map units are made up of two or more major soils. These map units are called soil complexes, soil associations, or undifferentiated groups.

A *soil complex* consists of two or more soils that occur as areas so intricately mixed or so small that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Amor-Cabba loams, 9 to 15 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. These dissimiliar soils are described in each map unit. Also, some of the more unusual or strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes some *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Badland is an example. Some miscellaneous areas are large enough to be delineated on the soil maps. Some that are too small to be delineated are identified by a special symbol on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

soil descriptions

3—Straw loam, channeled. This deep, level soil is well drained. It is on flood plains and terraces. Slope is 0 or 1 percent. This soil is frequently flooded. Individual areas are narrow and linear in shape and range from 5 acres to more than 50 acres in size.

Typically, the surface soil is 23 inches thick. It is dark grayish brown loam in the upper part, dark grayish brown silt loam in the middle part, and grayish brown silt loam in the lower part. The substratum is loam to a depth of 60 inches. It is grayish brown in the upper part and light brownish gray in the lower part. In some places the soil has a lighter colored and thinner surface layer. In a few places the soil is fine sandy loam.

Included with this soil in mapping are small areas of Harriet, Rhoades, and Cabba soils. The poorly drained Harriet soils and moderately well drained Rhoades soils have a sodic subsoil and contain more clay than this Straw soil. They are in swales. Cabba soils are shallow. They are on hills and ridges. Also included with this unit are small areas of cut streambanks, oxbows, and channels. These included soils make up about 20 percent of the unit.

Permeability is moderate, surface runoff is slow, and available water capacity is high.

Most areas of this soil are used as rangeland or for wildlife habitat. This soil is generally not suited to cultivated crops or hay. The steep-sided channels generally cannot be crossed by machinery. A cover of range or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the

protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and deferred grazing help keep the range and soil in good condition. A severe hazard of erosion from floodwater is present where the protective vegetative cover is overgrazed.

Straw loam, channeled, is generally not suited to the trees and shrubs grown as windbreaks and environmental plantings. Trees and shrubs can grow well, but the dissected nature of the unit limits its suitability for row planting and cultivating of trees. This soil frequently has a good stand of native woodland along the stream channel. Common species are green ash, bur oak, American elm, willow species, juneberry, common chokecherry, silver buffaloberry, and prairie rose. This habitat provides a diversity of food and cover for wildlife.

This soil is not suited to septic tank absorption fields and sites for buildings because of the flooding hazard. Better sites are on nearby uplands that are not subject to flooding.

This soil is in capability subclass VIw.

4—Arnegard loam, 1 to 3 percent slopes. This deep, nearly level soil is well drained. It is in swales on uplands. Individual areas are irregular in shape and range from 5 acres to about 50 acres in size.

Typically, the surface layer is very dark grayish brown loam about 10 inches thick. The subsoil is dark grayish brown and grayish brown loam about 32 inches thick. The substratum is light brownish gray to a depth of 60 inches. It is loam in the upper part and very fine sandy loam in the lower part. In some places the soil has more sand, in other places it has more clay, and in a few places it has a lighter colored surface layer and subsoil.

Included with this soil in mapping are small areas of Amor and Williams soils. Amor soils are moderately deep and are on side slopes. Williams soils have a thinner surface layer than the Arnegard soil and contain coarse fragments. They are on hilltops and side slopes. These included soils make up 10 percent of the unit.

Permeability is moderate, surface runoff is slow, and available water capacity is high. The surface layer is friable and easily tilled throughout a wide range in moisture content.

Most areas of this soil are used for cultivated crops. This soil is well suited to corn, flax, small grain, and grasses and legumes for pasture and hay. There is a slight hazard of soil blowing and water erosion. Tillage that leaves crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility and increase water infiltration.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Arnegard soil is well suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation, the soil's lying fallow the year preceding planting, and controlling competitive vegetation are important to the success of the planting.

This soil is well suited to sites for buildings and is suited to septic tank absorption fields. The moderate permeability is a limitation for septic tank absorption fields. This can be overcome by enlarging the absorption field. The shrinking and swelling of the soil is a limitation to sites for buildings. This can be overcome by reinforcing footings and basement walls and by providing good surface drainage by grading the surface away from the building.

This soil is in capability subclass IIc.

4B—Arnegard loam, 3 to 6 percent slopes. This deep, gently sloping soil is well drained. It is in swales on uplands. Individual areas are irregular in shape and range from 5 acres to about 50 acres in size.

Typically, the surface layer is very dark grayish brown loam about 10 inches thick. The subsoil is dark grayish brown and grayish brown loam about 32 inches thick. The substratum is light brownish gray to a depth of 60 inches. It is loam in the upper part and very fine sandy loam in the lower part. In some places the soil has more sand, in other places it has more clay, and in a few places it has a lighter colored, thinner surface layer.

Included with this soil in mapping are small areas of Amor and Williams soils. Amor soils are moderately deep and are on side slopes. Williams soils have a thinner surface layer than this Arnegard soil, and they have coarse fragments. They are on hilltops and side slopes. These included soils make up about 10 percent of the unit.

Permeability is moderate, surface runoff is medium, and available water capacity is high. The surface layer is friable and easily tilled throughout a wide range in moisture content.

Most areas of this soil are used for cultivated crops. This soil is well suited to corn, flax, small grain, and grasses and legumes for pasture and hay. There is a slight hazard of soil blowing, and a moderate hazard of water erosion. Tillage that leaves a moderate amount of crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility and increase water infiltration.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause

deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Arnegard soil is well suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation, the soil's lying fallow the year preceding planting, and controlling competitive vegetation are important to the success of the planting.

This soil is well suited to sites for buildings and is suited to septic tank absorption fields. The moderate permeability is a limitation for septic tank absorption fields. This can be overcome by enlarging the absorption field. Shrinking and swelling of the soil limits sites for buildings. This limitation can be overcome by reinforcing footings and basement walls and by providing good surface drainage by grading the surface away from the building.

This soil is in capability subclass IIe.

5—Tonka silt loam. This deep, level soil is poorly drained. It is in shallow depressions on glacial till uplands. Slope is 0 to 1 percent. This soil is frequently ponded, especially in the spring. Individual areas are generally circular in shape and range from 3 acres to about 30 acres in size.

Typically, the surface layer is dark gray silt loam about 8 inches thick. The subsurface layer is light brownish gray loam about 5 inches thick. The subsoil is about 23 inches thick. It is dark gray silty clay in the upper part, gray silty clay in the middle part, and grayish brown silty clay loam in the lower part. The substratum is light gray clay loam to a depth of 60 inches. In some places the soil is very poorly drained.

Included with this soil in mapping are small areas of Arnegard and Williams soils. Arnegard and Williams soils are well drained. Arnegard soils are on foot slopes, and Williams soils are on side slopes. These included soils make up about 10 percent of the unit.

Permeability is slow, and available water capacity is high. Surface runoff ponds. This soil has a seasonal high water table.

Most areas are used as rangeland or for hay or wetland wildlife habitat. This soil is poorly suited to cultivated crops. In undrained areas tillage and seeding are frequently delayed and sometimes prevented by surface ponding. A cover of range, pasture, or hay plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, deferred grazing, and avoidance of grazing when the soil is wet help keep the range and soil in good condition.

This Tonka soil is generally not suited to the trees and shrubs grown as windbreaks and environmental plantings, except where it is drained. Where the soil is adequately drained, all climatically adapted species of trees and shrubs can grow well.

This soil is well suited to wetland wildlife habitat. Management practices that regulate livestock use and maintain a buffer strip of vegetation surrounding the area help reduce siltation and damage to the wetland habitat. Most areas are surrounded by soils that are well suited to crops and vegetation that support wetland wildlife species.

This soil is not suited to sites for buildings and to septic tank absorption fields, and in this survey area it is generally avoided for these uses. Better suited sites are generally nearby.

This soil is in capability subclass IVw.

7—Straw-Rhoades loams. These deep, level soils are well drained and moderately well drained. They are on terraces and flood plains. The Rhoades soil is in shallow depressions. This unit is occasionally flooded. Slope is 0 to 1 percent. Individual areas are irregular in shape and range from 10 acres to more than 100 acres in size. They are made up of about 60 percent Straw soils and 30 percent Rhoades soils. These soils are so intricately mixed or so small in size that it is not practical to separate them in mapping.

Typically, the Straw soil has a surface soil 23 inches thick. The surface soil is dark grayish brown loam in the upper part, dark grayish brown silt loam in the middle part, and grayish brown silt loam in the lower part. The substratum is loam to a depth of 60 inches. It is grayish brown in the upper part and light brownish gray in the lower part. In some places the soil has more silt and in other places it has more sand. In a few places the soil is not flooded.

Typically, the Rhoades soil has a surface layer of grayish brown loam about 3 inches thick. The subsoil is dark grayish brown silty clay loam about 7 inches thick. The substratum to a depth of 60 inches is grayish brown silty clay in the upper part and light olive brown clay in the lower part. In some places the soil has a surface layer of silt loam more than 5 inches thick.

Included with these soils in mapping are small areas of Savage, Lawther, and Harriet soils. Savage and Lawther soils have more clay than the Straw and Rhoades soils. They are on uplands and are not subject to flooding. The poorly drained Harriet soils are in oxbows. These included soils make up about 10 percent of the unit.

Permeability is moderate in the Straw soil and very slow in the Rhoades soil. Surface runoff is slow on both soils. Available water capacity is high in the Straw soil and moderate in the Rhoades soil. Root penetration is restricted below a depth of about 3 inches by the dense, sodic subsoil in the Rhoades soil.

Most areas of this unit are used for cultivated crops. This unit is suited to corn, flax, small grain, and grasses and legumes for pasture and hay. There is a slight hazard of soil blowing and water erosion. Tillage that loosens the dense, sodic subsoil and growing deep rooted crops, such as alfalfa or sweetclover, improve

infiltration of roots and water. Avoiding tillage when the soils are wet helps prevent crusting and the formation of hard clods that make a poor seedbed. Tillage practices that leave crop residue on the surface, field windbreaks, and stripcropping help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility and increase water infiltration, especially in the Rhoades soil.

A cover of hay, pasture, or range plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

The Straw soil in this unit is well suited to the trees and shrubs grown as windbreaks and environmental plantings. The Rhoades soil is generally not suited to this use. Root penetration is restricted in the Rhoades soil by the dense, sodic subsoil. If the Straw soil is planted to trees and shrubs, site selection, site preparation, and controlling competitive vegetation are important to the success of the planting.

This unit is generally not suited to sites for buildings and to septic tank absorption fields because of the flooding. Better sites are on nearby uplands that are not subject to flooding.

This unit is in capability subclass IIIs.

8C—Cabba-Chama silt loams, 6 to 9 percent slopes. These shallow and moderately deep, moderately sloping soils are well drained. These soils are on uplands. Individual areas are irregular in shape and range from 5 acres to about 100 acres in size. They are made up of about 45 percent Cabba soils and 40 percent Chama soils. The Cabba soil is on ridges, and the Chama soil is on side slopes. These soils are so intricately mixed or so small in size that it is not practical to separate them in mapping.

Typically, the Cabba soil has a surface layer of grayish brown silt loam about 3 inches thick. The next layer is light brownish gray silt loam about 5 inches thick. The substratum is grayish brown silt loam to a depth of 18 inches. Below this is soft bedrock. In some places the soil is loam, and in other places it is silty clay loam.

Typically, the Chama soil has a surface layer of dark grayish brown silt loam about 8 inches thick. The subsoil is grayish brown silt loam about 4 inches thick. The substratum is silt loam to a depth of 30 inches. It is light brownish gray in the upper part and light gray in the lower part. Below this is soft bedrock. In some places the soil has more clay, in other places the soil is more than 10 inches deep to carbonates, and in a few places the soil is more than 40 inches deep to bedrock and contains a few coarse fragments.

Included with these soils in mapping are small areas of Farland and Rhoades soils. Farland soils are deep and on terraces. Rhoades soils have a dense, sodic subsoil and are on foot slopes. These included soils make up about 15 percent of the unit.

Permeability is moderate in the Cabba and Chama soils. Available water capacity is very low in Cabba soils and moderate in Chama soils. Surface runoff is medium for both soils. Root penetration is somewhat restricted by soft bedrock, which is at a depth of about 18 inches in the Cabba soil and at a depth of about 30 inches in the Chama soil.

Many areas of this unit are used for cultivated crops, but some are used for hay and pasture or as rangeland. This unit is poorly suited to corn, flax, and small grain. It is better suited to grasses and legumes for hay and pasture. There is a slight hazard of soil blowing and a severe hazard of water erosion. Tillage that leaves large amounts of crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility and increase water infiltration.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

The Chama soil is suited to the trees and shrubs grown in windbreaks and environmental plantings. Most climatically adapted species can grow well. The Cabba soil is generally not suited to trees because of the very low available water capacity and restricted rooting depth. If windbreaks are planted, they should be planted on the contour to reduce the hazard of erosion from melting snow.

These soils are suited to sites for buildings and are poorly suited to septic tank absorption fields. The shrinking and swelling of the soil is a limitation to sites for buildings. This can be overcome by using reinforced footings and basement walls and by providing good surface drainage by grading the surface away from the building. The bedrock is a limitation for construction but can be overcome because it is soft and easily excavated. Alternative systems to onsite waste disposal, such as holding tanks, should be considered. Effluent from septic tanks can follow bedding planes in the bedrock and can surface downslope or can contaminate groundwater.

This unit is in capability subclass IVe.

9D—Amor-Cabba loams, 9 to 15 percent slopes. These moderately deep and shallow, strongly sloping soils are well drained. They are on uplands. Many areas are dissected by drainageways. Individual areas are irregular in shape and range from 10 acres to more than 100 acres in size. They are made up of about 60 percent

Amor soils and 25 percent Cabba soils. The Amor soil is on side slopes, and the Cabba soil is on ridges. These soils are so intricately mixed or so small in size that it is not practical to separate them in mapping.

Typically, the Amor soil has a surface layer of dark grayish brown loam about 7 inches thick. The subsoil is dark brown and brown loam about 14 inches thick. The substratum is light brownish gray loam to a depth of about 34 inches. Below this is soft bedrock. In some places the soil has more clay, and in other places the soil is more than 40 inches deep to bedrock.

Typically, the Cabba soil has a surface layer of grayish brown loam about 3 inches thick. The next layer is light brownish gray silt loam about 5 inches thick. The substratum is grayish brown silt loam to a depth of 18 inches. Below this is soft bedrock. In some places the soil is loam, and in other places it is silty clay loam.

Included with these soils in mapping are small areas of Arnegard, Belfield, Rhoades, and Vebar soils. Arnegard, Belfield, and Rhoades soils are deep. Belfield and Rhoades soils have a sodic subsoil. They are in swales. Vebar soils have a surface layer and subsoil of fine sandy loam and are underlain by sandstone bedrock. They are on side slopes. These included soils make up about 15 percent of the unit.

Permeability is moderate in the Amor and Cabba soils, and surface runoff is rapid. Available water capacity is moderate in the Amor soil and very low in the Cabba soil. Root penetration is somewhat restricted by soft bedrock at a depth of about 18 inches in the Cabba soil and at a depth of about 34 inches in the Amor soil.

Most areas of this unit are used for pasture and hay or as rangeland. This unit is poorly suited to corn, flax, and small grain and is better suited to grasses and legumes for pasture and hay. There is a slight hazard of soil blowing and a severe hazard of water erosion. Tillage that leaves large amounts of crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Returning crop residue to the surface or the addition of organic material into the plow layer helps improve fertility and increase water infiltration.

A cover of pasture, hay, or range plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

The Amor soil in this unit is well suited to the trees and shrubs grown as windbreaks and environmental plantings. Most climatically adapted species can grow well. The Cabba soil is generally not suited because of the very low available water capacity and restricted rooting depth. If windbreaks are planned, they should be planted on the contour to reduce the hazard of erosion from melting snow.

These soils are suited to sites for buildings and are poorly suited to septic tank absorption fields. The shrinking and swelling of the soils is a limitation to sites for buildings. This can be overcome by providing reinforced footings and basement walls and by providing good surface drainage by grading the surface away from the building. The bedrock is a limitation that can be overcome because it is soft and easily excavated. Alternative systems to onsite waste disposal should be considered. Effluent from septic tanks can follow bedding planes in the bedrock and can surface downslope or can contaminate ground water.

This unit is in capability subclass IVe.

9E—Cabba loam, 15 to 45 percent slopes. This shallow, moderately steep to very steep soil is well drained. It is on uplands. Many areas are dissected by drainageways. Individual areas are irregular in shape and range from 10 acres to more than 100 acres in size.

Typically, the surface layer is grayish brown loam about 3 inches thick. The next layer is light brownish gray silt loam about 5 inches thick. The substratum is grayish brown silt loam to a depth of 18 inches. Below this is soft bedrock. In some places the surface layer is silt loam, in other places it is silty clay loam. In a few places the soil is 20 to 40 inches deep to bedrock.

Included with this soil in mapping are small areas of Arnegard, Rhoades, and Zahl soils. These soils are deep. Arnegard soils are in swales. Zahl soils are on knobs. Rhoades soils have a dense, sodic subsoil, and they are on foot slopes and in swales. Also included are small areas of very stony soils and a few areas of rock outcrop. These included soils make up about 15 percent of the unit.

Permeability is moderate, surface runoff is very rapid, and available water capacity is very low. Root penetration is somewhat restricted by soft bedrock at a depth of about 18 inches.

Most areas of this soil are used as rangeland and are better suited to this use. This soil is generally not suited to cultivated crops, hay, pasture, or to the trees and shrubs grown as windbreaks and environmental plantings. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This soil is poorly suited to sites for buildings and generally is not suitable for septic tank absorption fields. The slope is a limitation to sites for buildings. It can be overcome by designing buildings that conform to the slope of the land. Land shaping may be needed in some areas.

This soil is in capability subclass VIIe.

10D—Cabba extremely stony loam, 3 to 25 percent slopes. This shallow, gently sloping to moderately steep

soil is well drained. It is on uplands. Large stones of glacial or residual origin cover from 3 to 15 percent of the surface. Many areas are dissected by drainageways. Individual areas are irregular in shape and range from 5 acres to about 100 acres in size.

Typically, the surface layer is grayish brown extremely stony loam about 3 inches thick. The next layer is light brownish gray silt loam about 5 inches thick. The substratum is grayish brown silt loam to a depth of 18 inches. Below this is soft bedrock. In some places the soil has more sand, in other places it has more clay, and in a few places the soil is 20 to 40 inches deep to bedrock.

Included with this soil in mapping are small areas of Arnegard, Rhoades, Williams, and Zahl soils. These soils are deep. Arnegard soils are in swales, and Zahl soils are on knobs. Rhoades soils have a subsoil that is a dense, sodic claypan. They are on foot slopes and in swales. Williams soils are on level ridgetops. These included soils make up about 15 percent of the unit.

Permeability is moderate, surface runoff is rapid, and available water capacity is very low. Root penetration is somewhat restricted by soft bedrock at a depth of about 18 inches.

Most areas of this soil are used as rangeland and are better suited to this use. This soil is not suited to cultivated crops, hay, pasture, or the trees and shrubs grown as windbreaks and environmental plantings or to sanitary facilities. It is poorly suited to sites for buildings. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

The shrinking and swelling of the soil is a limitation to sites for buildings. This can be overcome by providing reinforced footings and by providing good surface drainage by grading the surface away from the buildings. Buildings should be designed to conform to the natural slope of the land. Land shaping may be needed in some areas. The bedrock is soft and easily excavated. Alternative systems of waste disposal, such as holding tanks, should be considered.

This soil is in capability subclass VIIs.

11F—Cabba-Badland complex, 15 to 120 percent slopes. This unit consists of shallow, moderately steep to very steep soils that are well drained and miscellaneous areas of Badland. This complex is on uplands. Individual areas are irregular in shape and range from 10 acres to more than 200 acres in size. They are made up of about 50 percent Cabba soils and about 30 percent Badland. The Cabba soil is on hills and side slopes, and the Badland is side slopes. The Cabba soil and the Badland are so intricately mixed or so small in size that it is not practical to separate them in mapping.

Typically, the Cabba soil has a surface layer of grayish brown loam about 3 inches thick. The next layer is light brownish gray silt loam about 5 inches thick. The substratum is grayish brown silt loam to a depth of 18 inches. Below this is soft bedrock. In some places the soil is fine sandy loam; in other places it is silty clay loam. In a few places it has porcelanite in the substratum.

Areas of Badland consist of exposed, silty and clayey sedimentary bedrock that is highly erodible. Badland typically is on south-facing slopes. It is barren of vegetation.

Included with this unit in mapping are small areas of Cherry, Moreau, Rhoades, Vanda, and Zahl soils. Moreau soils are on side slopes and are 20 to 40 inches deep to soft bedrock. Cherry, Rhoades, Vanda, and Zahl soils are deep. Cherry and Vanda soils are on fans and foot slopes. Rhoades soils are in swales, and Zahl soils are on knobs. Rhoades and Vanda soils have a sodic subsoil or substratum. These included soils make up about 20 percent of the unit.

Permeability is moderate in the Cabba soil, surface runoff is very rapid, and available water capacity is very low. Root penetration is somewhat restricted in the Cabba soil at a depth of about 18 inches. Soil slippage downslope is common in most of this unit.

Most areas of this unit are used as rangeland and are better suited to this use. The unit is not suited to cultivated crops, pasture, hay, or the trees and shrubs grown as windbreaks and environmental plantings. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition. Wooded drainageways and brush areas provide a diversity of cover for wildlife.

This unit is poorly suited to sites for buildings and is generally not suited to septic tank absorption fields. Buildings should be designed to conform to the natural slope of the land. Land shaping may be needed in some areas. The bedrock is soft and easily excavated.

This unit is in capability subclass VIIe.

12—Banks loamy sand, 1 to 3 percent slopes. This deep, nearly level soil is somewhat excessively drained. It is on flood plains and terraces. This soil is subject to frequent flooding. Individual areas are narrow and linear in shape and range from 10 acres to about 100 acres in size.

Typically, the surface layer is light brownish gray loamy sand and thin layers of silt and very fine sand. It is about 4 inches thick. The substratum is light brownish gray to a depth of 60 inches. It is fine sand in the upper part and stratified layers of fine sand and sand in the lower part. In some places the soil is loam or silt loam.

Included with this soil in mapping are small areas of the Trembles Variant. The Trembles Variant contains more clay than this Banks soil and is poorly drained. It is further away from the stream channel in the flood plain than the Banks soil. Also included are short, steep streambanks and a few oxbows and abandoned stream channels. These included soils make up about 15 percent of the unit.

Permeability is rapid, surface runoff is slow, and available water capacity is low.

Most areas of this soil are used as rangeland and are better suited to this use. This soil is generally not suited to cultivated crops, hay, pasture, or to the trees and shrubs grown as windbreaks and environmental plantings. A cover of range plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition. Many areas of this unit have stands of cottonwood, prairie rose, and willow species that provide a diversity of habitat for wildlife.

Banks soils are generally not suited to sites for buildings and to septic tank absorption fields because they are subject to flooding. Better sites are generally on nearby uplands that are not subject to flooding.

This soil is in capability subclass VIe.

13D—Wabek gravelly loam, 1 to 15 percent slopes. This deep, nearly level to strongly sloping soil is excessively drained. It is on outwash plains and terraces. This soil is very shallow over sand and gravel. Individual areas are irregular in shape and range from 5 acres to more than 50 acres in size.

Typically, the surface layer is dark grayish brown gravelly loam about 6 inches thick. The substratum to a depth of 60 inches is light brownish gray gravelly sandy loam in the upper part and yellowish brown, stratified very gravelly loamy sand and coarse sand in the lower part. In some places gravel is at a depth of 20 to 40 inches.

Included with this soil in mapping are small areas of Ruso and Parshall soils. Ruso soils have a surface layer of fine sandy loam. They are on terraces. Parshall soils have more sand than this Wabek soil and do not have gravel in the substratum. They are in swales. These included soils make up about 15 percent of the unit.

Permeability is very rapid, surface runoff is slow, and available water capacity is low.

Most areas of this soil are used as rangeland or for pasture. This soil is generally not suited to cultivated crops or the trees and shrubs grown as windbreaks and environmental plantings. It is better suited to rangeland. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This soil is suited to sites for buildings and is poorly suited to septic tank absorption fields. The slope is a limitation to sites for buildings. It can be overcome by designing buildings to conform to the natural slope of the land. Land shaping may be needed in some areas. Pollution of ground water is a hazard because of the very rapid permeability of the soil and possible inadequate filtration of effluent from septic tanks.

This soil is in capability subclass VIs.

15—Belfield-Farland silt loams, 1 to 3 percent slopes. These deep, nearly level soils are well drained. They are on terraces and uplands. Individual areas of this unit are irregular in shape and range from 5 acres to about 50 acres in size. They are made up of about 50 percent Belfield soils and 40 percent Farland soils. The Belfield soil is in swales, and the Farland soil is on terraces. These soils are so intricately mixed or so small in size that it is not practical to separate them in mapping.

Typically, the Belfield soil has a surface layer of dark grayish brown silt loam about 12 inches thick. The next layer is grayish brown silty clay loam and dark grayish brown silty clay about 2 inches thick. The subsoil is about 16 inches thick. It is dark grayish brown silty clay in the upper part and grayish brown silty clay loam in the lower part. The substratum is silty clay loam to a depth of 60 inches. It is pale olive and white in the upper part and pale yellow and white in the lower part. In some places the soil has more clay.

Typically, the Farland soil has a surface layer of dark grayish brown silt loam about 8 inches thick. The subsoil is light olive brown silty clay loam about 16 inches thick. The substratum to a depth of 60 inches is light brownish gray silty clay loam in the upper part and grayish brown silt loam in the lower part. In some places the soil has more clay, in other places the surface layer is thicker and darker colored, and in a few places the soil has more sand.

Included with these soils in mapping are small areas of Daglum and Rhoades soils. Daglum soils have a subsurface layer of grayish brown silt loam, and Rhoades soils have a thin surface layer of loam. Both soils are in slight depressions. These included soils make up about 10 percent of the unit.

Permeability is slow in the Belfield soil and moderate in the Farland soil. Surface runoff is slow, and available water capacity is high in both soils. Root penetration is somewhat restricted by the sodic subsoil in the Belfield soil at a depth of about 14 inches. The surface layer of both soils is friable and easily tilled throughout a wide range in moisture content.

Most areas of this unit are used for cultivated crops. This unit is suited to small grain, corn, flax, or grasses and legumes for hay and pasture. There is a slight

hazard of soil blowing and water erosion. Tillage practices that leave crop residue on the surface, field windbreaks, stripcropping, and grassed waterways help prevent excessive soil loss. Deep tillage or loosening the sodic subsoil of the Belfield soil by growing deep rooted crops, such as alfalfa or sweetclover, allows root and water penetration. The Belfield soil needs a cropping system that minimizes summer fallow and uses grasses to improve tilth. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility and increase water infiltration.

A cover of hay, pasture, or range plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

These Belfield and Farland soils are suited to the trees and shrubs grown as windbreaks and environmental plantings. The Farland soil is suited to more species. Trees and shrubs grow better on the Farland soil than on the Belfield soil. Root penetration is restricted by the sodic subsoil in the Belfield soil. Site selection, the soil's lying fallow the year preceding planting, site preparation, and controlling competitive vegetation are important to the success of the planting.

These soils are suited to sites for buildings and to septic tank absorption fields. The shrinking and swelling of these soils is a limitation to sites for buildings. This can be overcome by providing reinforced footings and basement walls and by providing good surface drainage by grading the surface away from the building. The slow or moderate permeability limits the use of these soils for septic tank absorption fields. This limitation can be overcome by enlarging the absorption fields. The Farland soil provides better suited sites than the Belfield soil for septic tank absorption fields.

This unit is in capability subclass IIIs.

16B—Belfield-Savage silty clay loams, 1 to 6 percent slopes. These deep, nearly level and gently sloping soils are well drained. They are on uplands. Individual areas are irregular in shape and range from 5 acres to more than 100 acres in size. They are made up of about 50 percent Belfield soils and about 40 percent Savage soils. The Belfield soil is in swales, and the Savage soil is on the lower part of side slopes and on foot slopes. These soils are so intricately mixed or so small in size that it is not practical to separate them in mapping.

Typically, the Belfield soil has a surface layer of dark grayish brown silty clay loam about 12 inches thick. The next layer is grayish brown silty clay loam and dark grayish brown silty clay about 2 inches thick. The subsoil is about 16 inches thick. It is dark grayish brown silty clay in the upper part and grayish brown silty clay loam in the lower part. The substratum is silty clay loam to a depth of 60 inches. It is pale olive and white in the upper part and pale yellow and white in the lower part. In some places the soil has a surface layer of silty clay.

Typically, the Savage soil has a surface layer of grayish brown silty clay loam about 5 inches thick. The subsoil is silty clay about 23 inches thick. It is grayish brown in the upper part and light brownish gray in the lower part. The substratum is light brownish gray silty clay to a depth of 60 inches. In some places the soil has less clay, in other places it is less than 40 inches deep to bedrock, and in a few places the surface layer is thicker and darker colored.

Included with these soils in mapping are small areas of Rhoades and Daglum soils. Daglum soils have a subsurface layer of grayish brown silt loam. Rhoades soils have a thin surface layer of loam. Both of these soils are in slight depressions. These included soils make up about 10 percent of the unit.

Permeability is slow, surface runoff is medium, and available water capacity is high. Root penetration is somewhat restricted by the sodic subsoil in the Belfield soil at a depth of about 14 inches.

Most areas of this unit are used for cultivated crops. This unit is suited to corn, flax, small grain, and grasses and legumes for pasture and hay. There is a slight hazard of soil blowing and a moderate hazard of water erosion. Tillage practices that leave a moderate amount of crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility and increase water infiltration. These soils tend to form hard clods if they are tilled when too wet or too dry. Tilth can be maintained or improved by cultivation when the soils are neither too wet or too dry. Deep tillage or loosening up the sodic subsoil of the Belfield soil by growing deep rooted crops, such as alfalfa or sweetclover, allows root and water penetration.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

The Belfield and Savage soils are suited to the trees and shrubs grown as windbreaks and environmental plantings. Site selection, site preparation, and controlling competitive vegetation are important to the success of the planting.

This unit is suited to sites for buildings and is poorly suited to septic tank absorption fields. The shrinking and swelling of the soils is a limitation to sites for buildings. This can be overcome by using reinforced footings and basement walls and by providing good surface drainage by grading the surface away from the building. The slow permeability limits the use of these soils for septic tank

absorption fields. It can be overcome by enlarging the absorption field or by the use of holding tanks and safe disposal of the effluent.

This unit is in capability subclass IIIe.

18—Belfield-Grail silty clay loams, 1 to 3 percent slopes. These deep, nearly level soils are well drained. They are on uplands. Individual areas are irregular in shape and range from 5 acres to about 50 acres in size. They are made up of about 45 percent Belfield soils and about 40 percent Grail soils. The Belfield soil is on convex slopes and in swales. The Grail soil is in swales. These soils are so intricately mixed or so small in size that it is not practical to separate them in mapping.

Typically, the Belfield soil has a surface layer of dark grayish brown silty clay loam about 12 inches thick. The next layer is grayish brown silty clay loam and dark grayish brown silty clay about 2 inches thick. The subsoil is about 16 inches thick. It is dark grayish brown silty clay in the upper part and grayish brown silty clay loam in the lower part. The substratum is silty clay loam to a depth of 60 inches. It is pale olive and white in the upper part and pale yellow and white in the lower part. In some places the surface layer is silty clay.

Typically, the Grail soil has a surface layer of dark grayish brown silty clay loam about 11 inches thick. The subsoil is dark grayish brown silty clay loam about 9 inches thick. The substratum to a depth of 60 inches is grayish brown silty clay loam in the upper part and grayish brown loam in the lower part. In some places the soil has more sand, in other places it has more clay, and in a few places it has a lighter colored surface layer.

Included with these soils in mapping are small areas of Daglum, Harriet, and Rhoades soils. Harriet soils are poorly drained and on flood plains. Daglum soils have a subsurface layer of grayish brown silt loam, and Rhoades soils have a thin surface layer of loam. Both of these soils are in slight depressions. These included soils make up about 15 percent of the unit.

Permeability and surface runoff are slow and available water capacity is high in the Belfield and Grail soils. Root penetration is somewhat restricted by the sodic subsoil in the Belfield soil at a depth of about 14 inches.

Most areas of this unit are used for cultivated crops. This unit is suited to small grain, corn, flax, and grasses and legumes for hay and pasture. There is a slight hazard of soil blowing and water erosion. Tillage practices that leave crop residue on the surface, field windbreaks, stripcropping, and grassed waterways help prevent excessive soil loss. Deep tillage or loosening the sodic subsoil of the Belfield soil by growing deep rooted crops, such as alfalfa or sweetclover, allows root and water penetration. Avoiding tillage of these soils when they are wet reduces crusting and the formation of hard clods that make a poor seedbed. The Belfield soil needs a cropping system that minimizes summer fallow and uses grasses to improve tilth. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility and increase water infiltration.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

These Belfield and Grail soils are suited to the trees and shrubs grown as windbreaks and environmental plantings. Site selection, site preparation, and controlling competitive vegetation are important to the success of the planting. Trees and shrubs grow better on the Grail soil than on the Belfield soil. In addition more species are adapted to the Grail soil than to the Belfield soil.

This unit is suited to sites for buildings and is poorly suited to septic tank absorption fields. The shrinking and swelling of these soils is a limitation to sites for buildings. This can be overcome by the use of reinforced footings and basement walls and by providing good surface drainage by grading the surface away from the building. The slow permeability limits the use of these soils for septic tank absorption fields. It can be overcome by enlarging the absorption field or by the use of holding tanks and safe disposal of the effluent.

This unit is in capability subclass IIIs.

19B—Belfield-Morton silt loams, 1 to 6 percent slopes. These deep and moderately deep, nearly level and gently sloping soils are well drained. They are on uplands. Individual areas are irregular in shape and range from 5 acres to about 75 acres in size. They are made up of about 50 percent Belfield soils and 35 percent Morton soils. The Belfield soil is on concave slopes and in swales. The Morton soil is on convex side slopes. These soils are so intricately mixed or so small in size that it is not practical to separate them in mapping.

Typically, the Belfield soil has a surface layer of dark grayish brown silt loam about 12 inches thick. The next layer is grayish brown silty clay loam and dark grayish brown silty clay about 2 inches thick. The subsoil is about 16 inches thick. It is dark grayish brown silty clay in the upper part and grayish brown silty clay loam in the lower part. The substratum is silty clay loam to a depth of 60 inches. It is pale olive and white in the upper part and pale yellow and white in the lower part. In some places the surface layer is silty clay. In other places it is thicker and darker colored.

Typically, the Morton soil has a surface layer of dark grayish brown silt loam about 5 inches thick. The subsoil is silt loam about 22 inches thick. It is dark yellowish brown in the upper part and light yellowish brown in the lower part. The substratum is light olive gray silt loam to a depth of 37 inches. Below this is soft bedrock. In some places the soil has a surface layer of silty clay loam, in

other places it has more sand, and in a few places the depth to bedrock is more than 40 inches.

Included with these soils in mapping are small areas of Daglum and Rhoades soils. Daglum soils have a subsurface layer of grayish brown silt loam, and the Rhoades soils have a thin surface layer of loam. Both of these soils are on foot slopes and in swales. These included soils make up about 15 percent of the unit.

Permeability is slow in the Belfield soil and moderate in the Morton soil. Surface runoff is medium, and available water capacity is high for the Belfield soil and moderate for the Morton soil. Root penetration is restricted by the sodic subsoil in the Belfield soil at a depth of about 14 inches. It is restricted by soft bedrock in the Morton soil at a depth of about 37 inches.

Most areas of this unit are used for cultivated crops. This unit is suited to corn, flax, small grain, and grasses and legumes for pasture and hay. There is a slight hazard of soil blowing and a moderate hazard of water erosion. Tillage practices that leave a moderate amount of crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Returning crop residue to the surface or the addition of organic material into the plow layer helps improve fertility and increase water infiltration.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

These Belfield and Morton soils are well suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation and controlling competitive vegetation are important to the success of the planting.

This unit is suited to sites for buildings and is poorly suited to septic tank absorption fields. The shrinking and swelling of these soils is a limitation to sites for buildings. This can be overcome by providing reinforced footings and basement walls and by providing good surface drainage by grading the surface away from the buildings. Effluent from septic tanks can follow bedding planes in the bedrock under the Morton soils and can surface downslope or can contaminate ground water. The slow permeability in the Belfield soil is a limitation for septic tank absorption fields. It can be overcome by enlarging the absorption field or by the use of holding tanks and safe disposal of the effluent.

This unit is in capability subclass IIIe.

21B—Cherry silty clay loam, 1 to 6 percent slopes. This deep, nearly level and gently sloping soil is well drained. It is on slightly convex fans, foot slopes, and side slopes of uplands (fig. 9). Individual areas are irregular in shape and range from 5 acres to more than 50 acres in size.

Typically, the surface layer is grayish brown silty clay loam about 4 inches thick. The subsoil is light brownish gray silty clay loam about 22 inches thick. The substratum is light brownish gray to a depth of 60 inches. It is silty clay loam in the upper part and stratified silty clay, silty clay loam, and silt loam in the lower part. In some places the soil has less clay, and in other places it has bedrock at a depth of 40 to 60 inches.

Included with this soil in mapping are small areas of Cabba and Vanda soils. Cabba soils are shallow and on ridges and hills. Vanda soils have a surface layer and substratum of silty clay and have excess amounts of sodium. They are on fans. These included soils make up about 15 percent of the unit.

Permeability is moderately slow, surface runoff is medium, and available water capacity is high.

Most areas of this soil are used for cultivated crops, pasture, range, or hay. This soil is suited to corn, flax, small grain, and grasses and legumes for pasture and hay. There is a slight hazard of soil blowing and a moderate hazard of water erosion. Tillage practices that leave moderate amounts of crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer help improve fertility and increase water infiltration. This soil tends to form hard clods if it is tilled when too wet or too dry. Tilth can be maintained or improved by cultivation when the soil is neither too wet or too dry.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Cherry soil is well suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation and controlling competitive vegetation are important to the success of the planting.

This soil is suited to sites for buildings and is poorly suited to septic tank absorption fields. The shrinking and swelling of the soil is a limitation to sites for buildings. This can be overcome by the use of reinforced footings and basement walls and by providing good surface drainage by grading the surface away from the building. The slow permeability limits the use of this soil for septic tank absorption fields. It can be overcome by enlarging the absorption field or by the use of holding tanks and safe disposal of the effluent.

This soil is in capability subclass IIIe.

21C—Cherry silty clay loam, 6 to 9 percent slopes. This deep, moderately sloping soil is well drained. It is on

Figure 9.—Cherry silty clay loam, 1 to 6 percent slopes, are in the foreground and Cabba-Badland complex, 15 to 120 percent slopes, are in the background. The Cabba-Badland complex is best suited to rangeland.

slightly convex fans, foot slopes, and side slopes of uplands. Individual areas are irregular in shape and range from 5 acres to about 50 acres in size.

Typically, the surface layer is grayish brown silty clay loam about 4 inches thick. The subsoil is light brownish gray silty clay loam about 22 inches thick. The substratum is light brownish gray to a depth of 60 inches. It is silty clay loam in the upper part and stratified silty clay, silty clay loam, and silt loam in the lower part. In some places the soil has less clay, in other places it has a thicker, darker colored surface layer, and in a few places it has bedrock at a depth of 20 to 40 inches.

Included with this soil in mapping are small areas of Cabba and Vanda soils. Cabba soils are shallow and on ridges and hills. Vanda soils have a surface layer and substratum of silty clay and have excessive amounts of sodium. They are on fans. These included soils make up about 15 percent of the unit.

Permeability is moderately slow, surface runoff is medium, and available water capacity is high.

Many areas of this soil are used for cultivated crops, but some are used for pasture and hay or as rangeland. This soil is suited to corn, flax, small grain, and grasses and legumes for pasture and hay. There is a slight hazard of soil blowing and a severe hazard of water erosion. Tillage that leaves large amounts of crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Returning crop residue to the surface helps improve fertility and increase water infiltration.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Cherry soil is well suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation and controlling competitive vegetation are important to the success of the planting. If windbreaks are planned, they should be planted on the contour to reduce the hazard of erosion from melting snow.

This soil is suited to sites for buildings and is poorly suited to septic tank absorption fields. The shrinking and swelling of this soil is a limitation to sites for buildings. This can be overcome by the use of reinforced footings and basement walls and by providing good surface drainage by grading the surface away from the building. The slow permeability limits the use of this soil for septic tank absorption fields. It can be overcome by enlarging the absorption field or by use of holding tanks and safe disposal of the effluent.

This soil is in capability subclass IIIe.

22—Colvin silt loam, saline. This deep, level soil is moderately saline and poorly drained. It is in swales and along drainageways of uplands. Slope is 0 to 1 percent. Flooding is frequent. Individual areas are linear in shape and range from 5 acres to about 30 acres in size.

Typically, the surface layer is dark gray silt loam about 14 inches thick. The substratum to a depth of 60 inches is grayish brown silt loam in the upper part; light brownish gray and light olive gray silty clay loam in the middle part; and gray, stratified sand, silt, and clay in the lower part. In some places the soil has a dense, sodic subsoil.

Included with this soil in mapping are small areas of well drained Grail and Straw soils. Grail and Straw soils do not have the layer of lime accumulation near the surface that the Colvin soil does. Grail soils are on foot slopes, and Straw soils are on flood plains. These included soils make up about 15 percent of the unit.

Permeability is moderately slow, surface runoff is very slow, and available water capacity is moderate. This soil has a seasonal high water table.

Most areas of this soil are used as rangeland or for hay. This soil is poorly suited to cultivated crops or the trees and shrubs grown as windbreaks and environmental plantings because of the presence of salts and the seasonal high water table. The hazard of soil blowing is moderate. Tillage that leaves a moderate amount of crop residue on the surface helps protect the soil from erosion. This soil is best suited to rangeland, hay, and wetland wildlife habitat. A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and deferred grazing help keep the range and soil in good condition. Grazing should be avoided when the soil is wet to prevent damage to the soil and vegetation.

The soil is well suited to wetland wildlife habitat. Management practices that regulate livestock use and maintain a buffer strip of vegetation surrounding the area help reduce siltation and damage to the wetland habitat. Many areas are surrounded by soils that are suited to growing crops and vegetation that support wetland wildlife species.

This soil is generally not suited to sites for buildings and to septic tank absorption fields because of the seasonal high water table, moderately slow permeability, and flooding. Better sites are generally on nearby uplands that do not flood.

This soil is in capability subclass IVw.

24—Dimmick clay. This deep, level soil is very poorly drained. It is in depressions of uplands and along abandoned stream channels. Slope is 0 to 1 percent. This soil is frequently ponded. Individual areas are circular in shape and range from 10 acres to about 400 acres in size.

Typically, the soil has a three-inch cover of decomposed plants. The surface layer is gray clay about 20 inches thick. The substratum is gray clay to a depth of 60 inches. In some places the soil is permanently ponded.

Included with this soil in mapping are small areas of poorly drained Harriet and Heil soils. These soils have a dense, sodic subsoil. They are on the outer edge of depressions. These included soils make up about 10 percent of the unit.

Permeability is very slow, available water capacity is high, and surface runoff ponds. This soil has a seasonal high water table.

Most areas of this unit are used as rangeland or for hay or wetland wildlife habitat. This soil is generally not suited to growing crops or the trees and shrubs grown as windbreaks and environmental plantings because of ponding and the seasonal high water table. It is suited to rangeland and hay. Except in dry years, forage is limited to summer and fall grazing because of ponding. A cover of range, hay, or pasture plants is effective in controlling erosion. Overgrazing or grazing when the soil is wet results in damage to the vegetation and soil. Proper stocking rates, pasture rotation, and deferred grazing help keep the soil and plant community in good condition.

The suitability of this soil for wetland wildlife habitat is good. Management practices that regulate livestock use and maintain a buffer strip of vegetation surrounding the area help prevent siltation and damage to the wetland habitat. Many areas are surrounded by soils that are suited to crops and vegetation that support wetland wildlife species.

This soil is not suited to sites for buildings and to septic tank absorption fields because of the seasonal high water table, ponding, very slow permeability, and high shrink-swell potential. Better suited sites are

generally on nearby uplands that are not subject to ponding.

This soil is in capability subclass Vw.

25F—Baahish-Rock outcrop complex, 15 to 120 percent slopes. This unit consists of deep, moderately steep to very steep soils that are somewhat excessively drained and rock outcrop (fig. 10). The Baahish soil is shallow over very gravelly material. The rock outcrop consists of a resistant limestone cap-rock. Many areas are dissected by drainageways. Individual areas are irregular in shape and range from 10 acres to several hundred acres in size. They are made up of about 55 percent Baahish soils and 25 percent rock outcrop. The rock outcrop is on the shoulder slopes, and the Baahish soil is on side slopes and foot slopes. The soil and rock outcrop are so intricately mixed or so small in size that it is not practical to separate them in mapping.

Typically, Baahish soils have a surface layer of very dark grayish brown fine sandy loam about 3 inches thick. The subsoil is about 10 inches thick. It is dark grayish brown sandy loam in the upper part and brown fine sandy loam in the lower part. The substratum is light gray to a depth of about 60 inches. It is very gravelly fine sandy loam in the upper part and very gravelly loam in the lower part. In some places the soil is shallow to soft bedrock. In other places the soil has a gravelly surface layer.

The rock outcrop part of the unit is escarpments of limestone and large limestone boulders. In some places, the rock is sandstone.

Figure 10.—Hay growing on Hidatsa soils, foreground. Baahish soils and rock outcrop, background, are on the slopes. The Baahish soils are used as rangeland.

Included with this unit in mapping are small areas of Arnegard, Hidatsa, Lakoa, and Rhoades soils. Arnegard soils are in swales. They do not have the gravelly material in the substratum that the Baahish soils have, and the Arnegard soils have a thick, dark surface layer. Hidatsa soils are moderately deep over gravelly material and are on foot slopes. Lakoa soils do not have a gravelly substratum. They are on wooded side slopes. Rhoades soils have a dense, sodic subsoil and are on foot slopes and in swales. These included soils make up about 20 percent of the unit.

Permeability is moderate in the surface and subsoil and rapid in the substratum. Surface runoff is very rapid. Available water capacity is low. Rooting depth is restricted by very gravelly fine sandy loam at a depth of about 13 inches.

Most areas of Baahish-Rock outcrop complex are used as rangeland or for wildlife habitat and are better suited to these uses. This unit is not suited to cultivated crops, hay, pasture, or the trees and shrubs grown as windbreaks and environmental plantings or to sanitary facilities. A cover of range plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition. Wooded draws and drainageways and patches of brush provide a diversity of habitat for wildlife.

This unit is poorly suited to sites for buildings. Buildings should be designed to conform to the natural slope of the land. Land shaping may be needed in some areas.

This unit is in capability subclass VIIe.

27—Farland silt loam, 1 to 3 percent slopes. This deep, nearly level soil is well drained. It is on terraces. Most areas are dissected by shallow drainageways and by streams. Individual areas are linear or irregular in shape and range from 5 acres to about 100 acres in size.

Typically, the Farland soil has a surface layer of dark grayish brown silt loam about 8 inches thick. The subsoil is light olive brown silty clay loam about 16 inches thick. The substratum to a depth of 60 inches is light brownish gray silty clay loam in the upper part and grayish brown silt loam in the lower part. In some places the soil has more clay, in other places it has a thicker, darker colored surface layer, and in a few places it has more sand.

Included with this soil in mapping are small areas of Daglum, Rhoades, Morton, and Regent soils. Daglum and Rhoades soils have a dense, sodic subsoil. They are in swales. Morton and Regent soils have soft bedrock at a depth of 20 to 40 inches, and they are on side slopes. These included soils make up about 15 percent of the unit.

Permeability is moderate, surface runoff is slow, and available water capacity is high. The surface layer is friable and easily tilled throughout a wide range in moisture content.

Most areas of this soil are used for cultivated crops. This soil is well suited to corn, flax, small grain, and grasses and legumes for pasture and hay. There is a slight hazard of soil blowing and water erosion. Tillage that leaves crop residue on the surface, field windbreaks, stripcropping, and grassed waterways help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility and increase water infiltration.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Farland soil is well suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation, the soil's lying fallow the year preceding planting, and controlling competitive vegetation are important to the success of the planting.

This unit is well suited to sites for buildings and is suited to septic tank absorption fields. The moderate shrinking and swelling of the soil is a limitation to sites for buildings. This can be overcome by the use of reinforced concrete footings and basement walls and by providing good surface drainage by grading the surface away from the building. The moderate permeability limits the use of this soil for septic tank absorption fields. It can be overcome by enlarging the absorption field.

This soil is in capability subclass IIc.

27B—Farland silt loam, 3 to 6 percent slopes. This deep, gently sloping soil is well drained. It is on terraces. Most areas are dissected by shallow drainageways and by streams. Individual areas are linear or irregular in shape and range from 5 acres to more than 100 acres in size.

Typically, the Farland soil has a surface layer of dark grayish brown silt loam about 8 inches thick. The subsoil is light olive brown silty clay loam about 16 inches thick. The substratum to a depth of 60 inches is light brownish gray silty clay loam in the upper part and grayish brown silt loam in the lower part. In some places the soil has more clay, in other places it has a thicker, darker colored surface layer, and in a few places it has more sand.

Included with this soil in mapping are small areas of Daglum, Rhoades, Morton, and Regent soils. Daglum and Rhoades soils have a dense, sodic subsoil. They are in swales. Morton and Regent soils have soft bedrock at a depth of 20 to 40 inches, and they are on side slopes. These included soils make up about 15 percent of the unit.

Permeability is moderate, surface runoff is medium, and available water capacity is high. The surface layer is friable and easily tilled throughout a wide range in moisture content.

Most areas of this soil are used for cultivated crops. This soil is well suited to corn, flax, small grain, and grasses and legumes for pasture and hay. There is a slight hazard of soil blowing and a moderate hazard of water erosion. Tillage practices that leave moderate amounts of crop residue on the surface, field windbreaks, stripcropping, and grassed waterways help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility and increase water infiltration.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Farland soil is well suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation, the soil's lying fallow the year preceding planting, and controlling competitive vegetation are important to the success of the planting.

This soil is well suited to sites for buildings and is suited to septic tank absorption fields. The moderate shrinking and swelling of the soil is a limitation to sites for buildings. This can be overcome by the use of reinforced concrete footings and basement walls and by providing good surface drainage by grading the surface away from the building. The moderate permeability limits the use of this soil for septic tank absorption fields. It can be overcome by enlarging the absorption field.

This soil is in capability subclass IIe.

29B—Farland-Rhoades silt loams, 1 to 6 percent slopes. These deep, nearly level and gently sloping soils are well drained and moderately well drained. They are on terraces and foot slopes of uplands. Individual areas are irregular in shape and range from 5 acres to more than 100 acres in size. They are made up of about 60 percent Farland soils and 25 percent Rhoades soils. The Farland soil is on terraces, and the Rhoades soil is in swales and on foot slopes. The soils are so intricately mixed or so small in size that it is not practical to separate them in mapping.

Typically, the Farland soil has a surface layer of dark grayish brown silt loam about 8 inches thick. The subsoil is light olive brown silty clay loam about 16 inches thick. The substratum to a depth of 60 inches is light brownish gray silty clay loam in the upper part and grayish brown silt loam in the lower part. In some places the soil has more clay, in other places it has a thicker, darker colored surface layer, and in a few places it has more sand.

Typically, the Rhoades soil has a surface layer of grayish brown silt loam about 3 inches thick. The subsoil is dark grayish brown silty clay loam about 7 inches thick. The substratum to a depth of 59 inches is grayish brown silty clay in the upper part and light olive brown clay in the lower part. Below this is soft bedrock. In places the soil has a thicker surface layer and a subsurface layer of grayish brown.

Included with these soils in mapping are small areas of Belfield, Morton, and Regent soils. Belfield soils have a sodic subsoil at a depth of about 14 inches. They are in swales. Morton and Regent soils have soft bedrock at a depth of 20 to 40 inches. They are on side slopes. Also included are small scabby areas that are barren of vegetation. These included soils make up about 15 percent of the unit.

Permeability is moderate in the Farland soil and very slow in the Rhoades soil. Surface runoff is medium for both soils. Available water capacity is high in the Farland soil and moderate in the Rhoades soil. In the Rhoades soil root penetration is restricted by the dense, sodic subsoil at a depth of about 3 inches.

Most areas of this unit are used for cultivated crops. These soils are suited to corn, flax, small grain, and grasses and legumes for pasture and hay. There is a slight hazard of soil blowing and a moderate hazard of water erosion. Deep tillage or loosening the dense, sodic subsoil of the Rhoades soil by growing deep rooted crops, such as alfalfa or sweetclover, allows root and water penetration. Avoiding tillage when the soil is wet helps prevent crusting and the formation of hard clods that make a poor seedbed. Tillage practices that leave moderate amounts of crop residue on the surface, field windbreaks, stripcropping, and grassed waterways help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer helps to improve fertility and increase water infiltration.

A cover of range, pasture, or hay plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

The Farland soil is well suited to the trees and shrubs grown as windbreaks and environmental plantings. The Rhoades soil generally is not suited to these uses. Root penetration is restricted in the Rhoades soil by a dense, sodic subsoil. If the Farland soil is planted to trees and shrubs, site selection, site preparation, and controlling competitive vegetation are important to the success of the planting.

The Farland soil is suited to sites for buildings and septic tank absorption fields. The Rhoades soil is poorly suited to these uses. The shrinking and swelling of these soils is a limitation to sites for buildings. This can be overcome by the use of reinforced footings and

basement walls and by providing good surface drainage by grading the surface away from the building. The moderate permeability limits the use of the Farland soil for septic tank absorption fields. It can be overcome by enlarging the absorption field. If areas of the Rhoades soil are used for waste disposal, holding tanks and safe disposal of the effluent should be considered.

This unit is in capability subclass IIIe.

30E—Cohagen-Vebar fine sandy loams, 9 to 25 percent slopes. These shallow and moderately deep, strongly sloping to moderately steep soils are somewhat excessively drained and well drained. They are on uplands. This unit is dissected by drainageways. Individual areas are irregular in shape and range from 10 acres to several hundred acres in size. They are made up of about 45 percent Cohagen soils and about 40 percent Vebar soils. The Vebar soil is on side slopes and foot slopes, and the Cohagen soil is on hills and ridges. These soils are so intricately mixed or so small in size that it is not practical to separate them in mapping.

Typically, the Cohagen soil has a surface layer of brown fine sandy loam about 4 inches thick. The substratum is light olive brown fine sandy loam to a depth of 15 inches. Below this is soft sandstone bedrock. In some places the soil has more silt and clay, and in a few places it is shallow over gravel.

Typically, the Vebar soil has a surface layer of dark grayish brown fine sandy loam about 8 inches thick. The subsoil is fine sandy loam about 15 inches thick. It is brown in the upper part and pale brown in the lower part. The substratum is light gray fine sandy loam to a depth of about 38 inches. Below this is soft sandstone bedrock. In some places the soil is deeper than 40 inches to soft bedrock, in other places the soil is eroded and has a lighter colored surface layer, and in a few places it has more silt and clay.

Included with these soils in mapping are small areas of Arnegard, Parshall, and Rhoades soils. Arnegard and Parshall soils have a thick, dark colored surface layer. They are in swales. Rhoades soils have a dense, sodic subsoil. They are in swales and on foot slopes. Also included are some very stony areas and areas of rock outcrop on ridges. These included soils make up about 15 percent of the unit.

Permeability is moderately rapid, and surface runoff is medium in both the Cohagen and Vebar soils. The available water capacity is very low in the Cohagen soil and low in the Vebar soil. Root penetration is somewhat restricted by soft bedrock at a depth of about 15 inches in the Cohagen soil and at a depth of 38 inches in the Vebar soil.

Most areas of this unit are used as rangeland. These soils are generally not suited to cultivated crops or to the trees and shrubs grown as windbreaks. They are best suited to rangeland and wildlife habitat. A cover of pasture or range plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition. Woody draws and areas of shrubs provide a diversity of wildlife habitat.

This unit is poorly suited to sites for buildings and generally is not suited to septic tank absorption fields. Buildings should be designed to conform to the natural slope of the land. Land shaping may be needed in some areas. The depth to bedrock and slope limit the use of these soils for septic tank absorption fields. These limitations are difficult to overcome. Effluent from septic tanks can follow bedding planes in the bedrock and can surface downslope or can contaminate ground water. Alternative systems to onsite disposal, such as holding tanks and safe disposal of the effluent, should be considered.

This unit is in capability subclass VIe.

31F—Cohagen-Vebar-Rock outcrop complex, 15 to 40 percent slopes. The shallow and moderately deep, moderately steep to very steep soils are somewhat excessively drained and well drained. These soils and sandstone rock outcrop are on uplands. Most areas are dissected by drainageways. Individual areas are irregular in shape and range from 10 acres to several hundred acres in size. They are made up of about 45 percent Cohagen soils, about 30 percent Vebar soils, and about 15 percent Rock outcrop. The Cohagen soil is on hills and ridges; the Vebar soil is on side slopes and foot slopes; and the Rock outcrop is on shoulder slopes. These soils and rock outcrops are so intricately mixed or so small in size that it is not practical to separate them in mapping.

Typically, the Cohagen soil has a surface layer of brown fine sandy loam about 4 inches thick. The substratum is light olive brown fine sandy loam to a depth of 15 inches. Below this is soft sandstone bedrock. In some places the soil has more silt and clay, and in other places it is shallow over gravel.

Typically, the Vebar soil has a surface layer of dark grayish brown fine sandy loam about 8 inches thick. The subsoil is fine sandy loam about 15 inches thick. It is brown in the upper part and pale brown in the lower part. The substratum is light gray fine sandy loam to a depth of about 38 inches. Below this is soft sandstone bedrock. In some places the soil is deeper than 40 inches to soft bedrock, in other places the soil has more silt and clay, and in a few places the soil is eroded and has a thinner, lighter colored surface layer.

Included with these soils in mapping are small areas of Arnegard, Parshall, and Rhoades soils. Arnegard and Parshall soils have a thick, dark colored surface layer. They are in swales. Rhoades soils have a dense, sodic subsoil. They are in swales and on foot slopes. These included soils make up 10 percent of the unit.

Permeability is moderately rapid, and surface runoff is rapid in both the Cohagen and Vebar soils. Available water capacity is very low in the Cohagen soil and low in the Vebar soil. Root penetration is somewhat restricted by soft bedrock at a depth of about 15 inches in the Cohagen soil and at a depth of about 38 inches in the Vebar soil.

Most areas of this unit are used as rangeland and for wildlife habitat and are better suited to these uses. These soils are generally not suited to cultivated crops or the trees and shrubs grown as windbreaks. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition. Wooded drainageways and brushy areas provide a diversity of cover and habitat for wildlife.

These soils are generally not suited to septic tank absorption fields and are poorly suited to sites for buildings. The bedrock and slope limit the use of these soils for septic tank absorption fields. These limitations are difficult to overcome. Effluent from septic tanks can follow bedding planes in the bedrock and can surface downslope or can contaminate ground water. Alternative systems to onsite disposal, such as holding tanks and safe disposal of the effluent, should be considered. Buildings should be designed to conform to the natural slope of the land. Land shaping may be needed in some areas.

This unit is in capability subclass VIIe.

32B—Flaxton-Williams complex, 1 to 6 percent slopes. These deep, nearly level and undulating soils are well drained. They are on glacial till plains. Individual areas are irregular in shape and range from 10 acres to about 75 acres in size. They are made up of about 50 percent Flaxton soils and about 35 percent Williams soils. These soils are so intricately mixed or so small in size that it is not practical to separate them in mapping.

Typically, the Flaxton soil has a surface layer of dark grayish brown fine sandy loam about 12 inches thick. The subsoil is about 30 inches thick. It is brown fine sandy loam in the upper part, grayish brown clay loam in the middle part, and light brownish gray clay loam in the lower part. The substratum is light brownish gray clay loam to a depth of 60 inches. In some places the soil is fine sandy loam to a depth of 60 inches, and in other places the soil is fine sandy loam to a depth of less than 20 inches.

Typically, the Williams soil has a surface layer of dark grayish brown loam about 8 inches thick. The subsoil is clay loam about 15 inches thick. It is brown in the upper part and light brownish gray in the lower part. The substratum is light gray clay loam to a depth of 60 inches.

Included with these soils in mapping are small areas of Noonan and Rhoades soils. Both soils are in shallow swales and have a dense, sodic subsoil. These included soils make up about 15 percent of the unit.

Permeability is moderately rapid in the upper part of the Flaxton soil and moderately slow in the lower part. It is moderately slow in the Williams soil. Surface runoff is slow, and available water capacity is high for both soils. The surface layer is friable and easily tilled throughout a wide range in moisture content.

Most areas of this unit are used for cultivated crops. These soils are suited to corn, flax, small grain, and grasses and legumes for pasture and hay. There is a severe hazard of soil blowing and a moderate hazard of water erosion. Tillage practices that leave large amounts of crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility and increase water infiltration.

A cover of hay, pasture, or range plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

These Flaxton and Williams soils are suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation, the soil's lying fallow the year preceding planting, and controlling competitive vegetation are important to the success of the planting.

These soils are well suited to sites for buildings and are suited to septic tank absorption fields. The shrinking and swelling of these soils is a limitation to sites for buildings. This can be overcome by providing good surface drainage by grading the surface away from the building and by using reinforced footings and basement walls. The slow permeability limits the use of these soils for septic tank absorption fields. It can be overcome by enlarging the absorption field.

This unit is in capability subclass IIIe.

32C—Flaxton-Williams complex, 6 to 9 percent slopes. These deep, gently rolling soils are well drained. They are on glacial till plains. Individual areas of this unit are irregular in shape and range from 10 acres to about 50 acres in size. They are made up of about 45 percent Flaxton soils and about 40 percent Williams soils. These soils are so intricately mixed or so small in size that it is not practical to separate them in mapping.

Typically, the Flaxton soil has a surface layer of dark grayish brown fine sandy loam about 12 inches thick. The subsoil is about 30 inches thick. It is brown fine sandy loam in the upper part, grayish brown loam in the middle part, and light brownish gray clay loam in the

lower part. The substratum is light brownish gray clay loam to a depth of 60 inches. In some places the soil is fine sandy loam to a depth of 60 inches, and in other places it is fine sandy loam to a depth of less than 20 inches.

Typically, the Williams soil has a surface layer of dark grayish brown loam about 8 inches thick. The subsoil is clay loam about 15 inches thick. The subsoil is clay loam about 15 inches thick. It is brown in the upper part and light brownish gray in the lower part. The substratum is light gray clay loam to a depth of 60 inches. In some places the surface layer is thinner.

Included with these soils in mapping are small areas of Noonan and Rhoades soils. Both soils are in shallow swales and have a dense, sodic subsoil. These included soils make up about 15 percent of the unit.

Permeability is moderately rapid in the upper part of the Flaxton soil and moderately slow in the lower part. It is moderately slow in the Williams soil. Surface runoff is medium, and available water capacity is high in both soils. The surface layer is friable and easily tilled throughout a wide range in moisture content.

Most areas of this unit are used for cultivated crops. These soils are poorly suited to corn, flax, and small grain but are well suited to grasses and legumes for pasture and hay. There is a severe hazard of soil blowing and water erosion. Tillage practices that leave large amounts of crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility and increase water infiltration.

A cover of range, pasture, or hay plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

These Flaxton and Williams soils are suited to the trees and shrubs grown as windbreaks and environmental planting. Site preparation, the soil's lying fallow the year preceding planting, and controlling competitive vegetation are important to the success of the planting.

These soils are suited to sites for buildings and to septic tank absorption fields. The shrinking and swelling of these soils is a limitation to sites for buildings. This can be overcome by providing good surface drainage by grading the surface away from the building and by using reinforced footings and basement walls. The slow permeability limits the use of these soils for septic tank absorption fields. It can be overcome by enlarging the absorption field.

This unit is in capability subclass IVe.

33—Grail silt loam, 1 to 3 percent slopes. This deep, nearly level soil is well drained. It is in swales on uplands. Many areas are dissected by shallow drainageways. Individual areas are linear in shape and range from 5 acres to about 50 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 11 inches thick. The subsoil is dark grayish brown silty clay loam about 9 inches thick. The substratum is grayish brown to a depth of 60 inches. It is silty clay loam in the upper part and loam in the lower part. In some places the soil has more sand, in other places it has a surface layer of silty clay loam or silty clay, and in a few places it has a thinner, lighter colored surface layer.

Included with this soil in mapping are small areas of Belfield soils. Belfield soils have a sodic subsoil. They are in swales. This included soil makes up about 10 percent of the unit.

Permeability and surface runoff are slow, and available water capacity is high. The surface layer is friable and easily tilled throughout a wide range in moisture content.

Most areas of this soil are used for cultivated crops. This soil is well suited to corn, flax, small grain, or grasses and legumes for pasture and hay. There is a slight hazard of soil blowing and water erosion. Tillage that leaves crop residue on the surface, field windbreaks, stripcropping, and grassed waterways help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer help improve fertility and increase water infiltration.

A cover of pasture, hay, or range plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Grail soil is well suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation, the soil's lying fallow the year preceding planting, and controlling competitive vegetation are important to the success of the planting.

This soil is suited to sites for buildings and is generally poorly suited to septic tank absorption fields. The shrinking and swelling of the soil is a limitation to sites for buildings. This can be overcome by providing good surface drainage by grading the surface away from the building and by using reinforced footings and basement walls. The slow permeability limits the use of this soil for septic tank absorption fields. It can be overcome by enlarging the absorption field.

This soil is in capability subclass IIc.

33B—Grail silt loam, 3 to 6 percent slopes. This deep, gently sloping soil is well drained. It is in swales on uplands. Many areas are dissected by shallow drainageways. Individual areas are linear in shape and range from 5 acres to about 50 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 11 inches thick. The subsoil is dark grayish brown silty clay loam about 9 inches thick. The substratum is grayish brown to a depth of 60 inches. It is silty clay loam in the upper part and loam in the lower part. In some places the soil has more sand, in other places it has a surface layer of silty clay loam or silty clay, and in a few places it has a thinner and lighter colored surface layer.

Included with this soil in mapping are small areas of Belfield soils. Belfield soils have a sodic subsoil. They are in swales. This included soil makes up about 10 percent of the unit.

Permeability is moderately slow, surface runoff is medium, and available water capacity is high. The surface layer is friable and easily tilled throughout a wide range in moisture content.

Most areas of this soil are used for cultivated crops. This soil is well suited to corn, flax, small grain, and grasses and legumes for pasture and hay. There is a slight hazard of soil blowing and a moderate hazard of water erosion. Tillage practices that leave moderate amounts of crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility and increase water infiltration.

A cover of hay, pasture, or range plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Grail soil is well suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation, the soil's lying fallow the year preceding planting, and controlling competitive vegetation are important to the success of the planting.

This soil is suited to sites for buildings and is generally poorly suited to septic tank absorption fields. The shrinking and swelling of this soil is a limitation to sites for buildings. This can be overcome by providing good surface drainage by grading the surface away from the buildings and by using reinforced footings and basement walls. The slow permeability limits the use of the soil for septic tank absorption fields. It can be overcome by enlarging the absorption field.

This soil is in capability subclass IIe.

35—Lawther silty clay, 1 to 3 percent slopes. This deep, nearly level soil is well drained. It is in swales on uplands. Individual areas are irregular in shape and range from 10 acres to more than 100 acres in size.

Typically, the surface layer is silty clay about 10 inches thick. It is grayish brown in the upper part and dark grayish brown in the lower part. The subsoil is grayish brown silty clay about 20 inches thick. The substratum to a depth of 60 inches is olive gray silty clay loam in the upper part and grayish brown silty clay in the lower part. In some places the soil has a surface layer of silt loam or silty clay loam.

Included with this soil in mapping are small areas of Harriet, Heil, and Rhoades soils. Harriet soils are on flood plains, Heil soils are in shallow basins, and Rhoades soils are in shallow, concave swales. These soils are sodic and have a dense, sodic subsoil. These included soils make up about 10 percent of the unit.

Permeability is slow, surface runoff is slow, and available water capacity is high.

Most areas of this soil are used for cultivated crops. This soil is well suited to corn, flax, small grain, or grasses and legumes for pasture and hay. There is a moderate hazard of soil blowing and a slight hazard of water erosion. Tillage practices that leave large amounts of crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility and increase water infiltration. The surface layer tends to form hard clods if tilled when it is too wet or too dry. Tilth can be maintained or improved by cultivation when the soil is neither too wet or too dry.

A cover of hay, range, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Lawther soil is suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation, the soil's lying fallow the year preceding planting, and controlling competitive vegetation are important to the success of the plantings.

This soil is poorly suited to sites for buildings and is generally not suited to septic tank absorption fields. The shrinking and swelling of this soil is a limitation to sites for buildings. This can be overcome by providing good surface drainage by grading the surface away from the building and by using reinforced footings and basement walls. The slow permeability limits the use of this soil for septic tank absorption fields. It is difficult to overcome. The use of holding tanks and the safe disposal of the effluent should be considered.

This soil is in capability subclass IIs.

35B—Lawther silty clay, 3 to 6 percent slopes. This deep, gently sloping soil is well drained. It is in swales on uplands. Individual areas are irregular in shape and range from 10 acres to more than 100 acres in size.

Typically, the surface layer is silty clay about 10 inches thick. It is grayish brown in the upper part and dark grayish brown in the lower part. The subsoil is grayish

brown silty clay about 20 inches thick. The substratum to a depth of 60 inches is olive gray silty clay loam in the upper part and grayish brown silty clay in the lower part. In some places the soil has a surface layer of silt loam or silty clay loam.

Included with this soil in mapping are small areas of Harriet, Heil, and Rhoades soils. Harriet soils are on flood plains, Heil soils are in shallow basins, and Rhoades soils are in shallow swales. These soils have a dense, sodic subsoil. These included soils make up about 10 percent of the unit.

Permeability is slow, surface runoff is medium, and available water capacity is high.

Most areas of this soil are used for cultivated crops. This soil is suited to corn, flax, small grain, and grasses and legumes for pasture and hay. There is a moderate hazard of soil blowing and water erosion. Tillage practices that leave a large amount of crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility and increase water infiltration. The surface layer tends to form hard clods if tilled when it is too wet or too dry. Tilth can be improved or maintained by cultivation when the soil is neither too dry or too wet.

A cover of hay, pasture, or range plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Lawther soil is suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation, the soil's lying fallow the year preceding planting, and controlling competitive vegetation are important to the success of the planting.

This soil is poorly suited to sites for buildings and is generally not suited to septic tank absorption fields. The shrinking and swelling of this soil is a limitation to sites for buildings. This can be overcome by providing good surface drainage by grading the surface away from the building and by using reinforced footings and basement walls. The slow permeability limits the use of this soil for septic tank absorption fields. It is difficult to overcome. The use of holding tanks and safe disposal of the effluent should be considered.

This soil is in capability subclass IIIe.

37—Trembles Variant fine sandy loam. This deep, level soil is poorly drained. It is on flood plains. Slope is 0 to 1 percent. This soil is subject to frequent floods of very long duration. Individual areas are long and narrow in shape and range from 10 acres to more than 200 acres in size.

Typically, the surface layer is light brownish gray fine sandy loam about 12 inches thick. The substratum is fine sandy loam to a depth of 60 inches. It is light brownish gray in the upper part, grayish brown in the middle part, and light brownish gray in the lower part. In some places the soil has more sand, and in other places it has more silt and clay.

Included with this soil in mapping are small areas of well drained Havrelon and Vanda soils. Havrelon soils have a surface layer and substratum of silt loam. Vanda soils have a surface layer and substratum of silty clay and are on fans. These included soils make up about 10 percent of the unit.

Permeability is moderately rapid, surface runoff ponds, and available water capacity is moderate. This soil has a seasonal high water table.

Most areas of this soil are used as rangeland and for wildlife habitat and are better suited to these uses. This soil is generally not suited to cultivated crops, the trees and shrubs grown as windbreaks and environmental plantings, or hay. The quality and quantity of forage species for cattle is poor because of the ponding of floodwater. Most areas have thin stands of willow species, brush, and weeds.

This soil is not suited to sites for buildings and to septic tank absorption fields because of the high water table and flooding. Better sites are generally on nearby uplands that are not subject to flood.

This soil is in capability subclass VIw.

39—Havrelon silt loam. This deep, level soil is well drained. It is on flood plains. Slope is 0 to 1 percent. This unit is commonly dissected by gullies, shallow drainageways, and stream channels. The soil is occasionally flooded for brief periods. Individual areas are irregular in shape and range from 10 acres to more than 50 acres in size.

Typically, the surface layer is grayish brown silt loam about 4 inches thick. The substratum is silt loam to a depth of 60 inches. It is light brownish gray in the upper part, gray and light gray in the middle part, and light brownish gray in the lower part. In some places the soil has more sand. In other places the surface layer is thicker and darker colored.

Included with this soil in mapping are small areas of Banks and Vanda soils. Banks soils have a surface layer of loamy sand, and Vanda soils are silty clay throughout. Vanda soils are on fans. These included soils make up about 10 percent of the unit.

Permeability is moderate, surface runoff is slow, and available water capacity is high. This soil has a seasonal high water table. The surface layer is friable and easily tilled throughout a wide range in moisture content.

Most areas of this soil are used for cultivated crops and pasture. This soil is well suited to corn, flax, small grain, and grasses and legumes for pasture and hay. There is a moderate hazard of soil blowing and a slight hazard of water erosion. Tillage that leaves moderate amounts of crop residue on the surface, field

windbreaks, stripcropping, grassed waterways, and diversions can help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility and increase water infiltration.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition. A serious hazard of erosion from floodwater is present where the protective vegetative cover is overgrazed.

This Havrelon soil is well suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation and controlling competitive vegetation are important to the success of the planting. Many areas of this soil have a good stand of native woodland. Common species are cottonwood, green ash, various species of willow, juneberry, common chokecherry, silver buffaloberry, and prairie rose. This provides a diversity of cover and food for wildlife.

This soil is generally not suited to sites for buildings and septic tank absorption fields because of flooding. Better sites are generally on nearby uplands that are not flooded.

This soil is in capability subclass IIe.

40—Havrelon silt loam, channeled. This deep, level and nearly level soil is well drained. It is on flood plains dissected by meandering drainageways and small stream channels. Slope ranges from 0 to 3 percent. This soil is generally in narrow valleys bounded by steep slopes. Flooding is frequent. Individual areas are linear in shape and range from 10 acres to more than 100 acres in size.

Typically, the surface layer is grayish brown silt loam about 4 inches thick. The substratum is silt loam to a depth of 60 inches. It is light brownish gray in the upper part, gray and light gray in the middle part, and light brownish gray in the lower part. In some places the soil has more sand. In other places the surface layer is thicker and darker colored.

Included with this soil in mapping are small areas of Banks and Vanda soils. Banks soils have a surface layer of loamy sand, and Vanda soils are silty clay throughout. Vanda soils are on fans. These included soils make up about 10 percent of the unit.

Permeability is moderate, surface runoff is slow, and available water capacity is high. This soil has a seasonal high water table.

Most areas of this soil are used as rangeland and for wildlife habitat. This soil is generally not suited to cultivated crops, the trees and shrubs grown as windbreaks and environmental plantings, or hay. The steep-sided channels generally cannot be crossed by machinery. A cover of range or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition. There is a serious hazard of erosion from floodwater where the protective vegetative cover is overgrazed.

This Havrelon soil is generally not suited to the trees and shrubs grown as windbreaks and environmental plantings. Trees and shrubs usually grow well in this soil, but the dissected nature of the unit limits its suitability for the row planting and cultivating of trees. In many places this soil supports a good stand of native woodland. Common species are green ash, bur oak, American elm, willow species, juneberry, common chokecherry, silver buffaloberry, and prairie rose. This habitat provides a diversity of food and cover for wildlife.

This soil is not suited to septic tank absorption fields and to sites for buildings because of flooding. Better sites are generally on nearby uplands that are not flooded.

This soil is in capability subclass VIw.

41—Heil silty clay loam. This deep, level soil is poorly drained. It is in shallow basins on uplands. Slope is 0 to 1 percent. Surface ponding is frequent. Individual areas of this soil are irregular in shape and range from 5 acres to about 100 acres in size.

Typically, the surface layer is gray silty clay loam about 3 inches thick. The subsoil is silty clay about 24 inches thick. It is gray in the upper part and light olive gray in the lower part. The substratum extends to a depth of 60 inches. It is light olive gray silty clay in the upper part and gray clay loam in the lower part. In some places the soil has lime within 10 inches of the surface.

Included with this soil in mapping are small areas of very poorly drained Dimmick soils and well drained Lawther soils. These soils do not have a sodic subsoil. Dimmick soils are in deep depressions; Lawther soils are in swales adjacent to depressions. These included soils make up about 10 percent of the unit.

Permeability is very slow, surface runoff ponds, and available water capacity is moderate. This soil has a seasonal high water table.

Most areas of this soil are used as rangeland. This soil is not suited to cultivated crops or the trees and shrubs grown as windbreaks and environmental plantings because of the excess sodium and salt content, surface ponding, and a seasonal water table. A cover of range, pasture, or hay plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and deferred grazing help keep the range and soil in good condition. Grazing should be restricted during wet periods to prevent damage to the vegetation and soil.

This soil is suited to wetland wildlife habitat. Management practices that regulate livestock use and maintain a buffer strip of vegetation surrounding the area help prevent siltation and damage to the wetland habitat. Most areas are surrounded by soils that are suited to growing crops and vegetation that support wetland wildlife.

This soil is not suited to sites for buildings and to septic tank absorption fields because of the seasonal high water table, frequent surface ponding, high shrink-swell potential, and very slow permeability. Better sites are generally nearby.

This soil is in capability subclass VIs.

42B—Lefor fine sandy loam, 1 to 6 percent slopes. This moderately deep, nearly level and gently sloping soil is well drained. It is on side slopes and foot slopes of uplands. Individual areas are irregular in shape and range from 10 acres to about 150 acres in size.

Typically, the surface layer is grayish brown fine sandy loam about 8 inches thick. The subsoil is about 20 inches thick. It is brown sandy loam in the upper part and light gray sandy clay loam in the lower part. Below this is soft sandstone bedrock. In some places the subsoil is fine sandy loam, and in other places the surface layer is loam or clay loam.

Included with this soil in mapping are small areas of Ekalaka soils and the Moreau Variant. Ekalaka soils have a dense, sodic subsoil. They are on concave slopes. The Moreau Variant contains more clay, is shallow to soft bedrock, and is on ridges. These included soils make up about 10 percent of the unit.

Permeability is moderate, surface runoff is slow, and available water capacity is low. When tilled, the surface layer crusts and forms hard clods. Root penetration is somewhat restricted by soft bedrock at a depth of about 28 inches.

Most areas of this soil are used for cultivated crops. This soil is suited to corn, flax, small grain, and grasses and legumes for pasture and hay. There is a severe hazard of soil blowing and a moderate hazard of water erosion. Tillage practices that leave large amounts of crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Returning crop residue to the soil or the addition of other organic material into the plow layer helps improve fertility and increase water infiltration.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Lefor soil is suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation, the soil's lying fallow the year preceding planting, and controlling competitive vegetation are important to the success of the planting.

This soil is suited to sites for buildings and is poorly suited to septic tank absorption fields. The shrinking and swelling in this soil is a limitation to sites for buildings. This can be overcome by providing good surface drainage by grading the surface away from the building and by using reinforced footings and basement walls. The bedrock is soft and easily excavated. The depth to bedrock limits the use of this soil for septic tank absorption fields. This limitation is difficult to overcome. Effluent from septic tanks can follow bedding planes in the bedrock and can surface downslope or can contaminate ground water. Alternative systems of disposal, such as holding tanks and safe disposal of the effluent, should be considered.

This soil is in capability subclass IIIe.

42C—Lefor fine sandy loam, 6 to 9 percent slopes. This moderately deep, moderately sloping soil is well drained. It is on side slopes and foot slopes of uplands. Individual areas are irregular in shape and range from 10 acres to about 150 acres in size.

Typically, the surface layer is grayish brown fine sandy loam about 8 inches thick. The subsoil is about 20 inches thick. It is brown sandy loam in the upper part and is light gray sandy clay loam in the lower part. Below this is soft sandstone bedrock. In some places the subsoil is fine sandy loam, and in other places the surface layer is loam or clay loam.

Included with this soil in mapping are small areas of Ekalaka soils and Moreau Variant. Ekalaka soils have a dense, sodic subsoil. They are on concave slopes. The Moreau Variant has more clay and is shallow to soft bedrock. It is on ridges. These included soils make up about 10 percent of the unit.

Permeability is moderate, surface runoff is medium, and available water capacity is low. When tilled, the surface becomes hard and crusts and forms large clods. Root penetration is somewhat restricted by soft bedrock at a depth of about 28 inches.

Most areas of this soil are used for cultivated crops. This soil is poorly suited to corn, flax, and small grain and is suited to grasses and legumes for pasture and hay. There is a severe hazard of soil blowing and water erosion. Tillage that leaves large amounts of crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Maintaining a protective vegetative cover, such as alfalfa or grasses; minimizing summer fallow; and avoiding low residue crops also help prevent soil erosion. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility and increase water infiltration.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause

deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Lefor soil is suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation, the soil's lying fallow the year preceding planting, and controlling competitive vegetation are important to the success of the planting. Where windbreaks are planned, they should be planted on the contour to help control soil erosion from melting snow.

This soil is suited to sites for buildings and is poorly suited to septic tank absorption fields. The shrinking and swelling of this soil is a limitation to sites for buildings. This can be overcome by providing good surface drainage by grading the surface away from the building and by using reinforced footings and basement walls. The bedrock is soft and easily excavated. The depth to rock limits the use of this soil for septic tank absorption fields. This limitation is difficult to overcome. Effluent from septic tanks can follow bedding planes in the bedrock and can surface downslope or can contaminate ground water. Alternative systems of disposal, such as holding tanks and safe disposal of the effluent, should be considered.

This soil is in capability subclass IVe.

43B—Havrelon silt loam, fan, 1 to 6 percent slopes. This deep, nearly level and gently sloping soil is well drained. It is on alluvial fans. This soil is commonly dissected by shallow gullies. It is occasionally flooded and receives runoff from adjacent uplands. Individual areas are irregular in shape and range from 10 acres to about 100 acres in size.

Typically, the surface layer is grayish brown silt loam about 4 inches thick. The substratum is silt loam to a depth of 60 inches. It is light brownish gray in the upper part, gray and light gray in the middle part, and light brownish gray in the lower part. In some places the soil has a surface layer and substratum of loam.

Included with this soil in mapping are small areas of Cherry and Vanda soils. Cherry soils have a surface layer of silty clay loam, and they are on fans and foot slopes. Vanda soils have a surface layer of silty clay, and they are on fans and terraces. These included soils make up about 15 percent of the unit.

Permeability is moderate, surface runoff is medium, and available water capacity is high. The surface layer is friable and easily tilled throughout a wide range in moisture content.

Most areas of this soil are used for pasture, range, or hay. This soil is suited to such crops as corn, flax, and small grain and to grasses and legumes for pasture and hay. There is a moderate hazard of soil blowing and water erosion. Tillage practices that leave large amounts of crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss and the formation of gullies. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility and increase water infiltration.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Havrelon soil is well suited to windbreaks and environmental plantings. Site preparation, control of surface runoff from adjacent slopes, and controlling competitive vegetation are important to the success of the planting.

This soil is not suited to sites for buildings and to septic tank absorption fields because of flooding. Better sites are generally on nearby uplands that are not flooded.

This soil is in capability subclass IIe.

44B—Lihen loamy fine sand, 1 to 6 percent slopes. This deep, nearly level and gently sloping soil is well drained. It is on uplands. Individual areas are irregular in shape and range from 10 acres to more than 100 acres in size.

Typically, the surface layer is dark grayish brown loamy fine sand about 18 inches thick. The next layer is brown loamy fine sand about 14 inches thick. The substratum is fine sand to a depth of 60 inches. It is light olive brown in the upper part and light brownish gray in the lower part. In some places the soil is eroded, and the surface layer is thinner and lighter colored.

Included with this soil in mapping are small areas of Cohagen, Parshall, and Vebar soils. Cohagen soils are shallow and on ridges. Vebar soils are moderately deep and on side slopes. Parshall soils are in swales and have a surface layer of fine sandy loam. These included soils make up about 10 percent of the unit.

Permeability is rapid, surface runoff is slow, and available water capacity is low. The surface layer is friable and easily tilled throughout a wide range in moisture content.

Most areas of this soil are used as rangeland, but some are used for cultivated crops. This soil is poorly suited to corn, flax, and small grain. It is better suited to grasses and legumes for pasture and hay. There is a very severe hazard of soil blowing and a moderate hazard of water erosion. Tillage that leaves large amounts of crop residue on the surface, leaving buffer strips, and maintaining an adequate vegetative cover help control wind and water erosion. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility and water holding capacity.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause

deterioration of the desired plant community. A very serious hazard of soil blowing exists where the plant cover is damaged. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Lihen soil is suited to the trees and shrubs grown as windbreaks and environmental plantings. Careful site selection, site preparation, controlling competitive vegetation, and the soil's lying fallow the year preceding planting are important to the success of the planting.

This soil is well suited to sites for buildings and is poorly suited to septic tank absorption fields. Because of the rapid permeability, the soil may not adequately filter effluent from septic tank absorption fields. There is a possibility of effluent contaminating ground water.

This soil is in capability subclass IVe.

44D—Lihen loamy fine sand, 6 to 15 percent slopes. This deep, moderately sloping and strongly sloping soil is well drained. It is on uplands. Individual areas are irregular in shape and range from 15 acres to more than 100 acres in size.

Typically, the surface layer is dark grayish brown loamy fine sand about 18 inches thick. The next layer is brown loamy fine sand about 14 inches thick. The substratum is fine sand to a depth of 60 inches. It is light olive brown in the upper part and light brownish gray in the lower part. In some places the surface layer is thinner and lighter colored.

Included with this soil in mapping are small areas of Cohagen, Parshall, and Vebar soils. Cohagen soils are shallow and on ridges. Parshall soils are in swales and have a surface layer of fine sandy loam. Vebar soils have soft bedrock at a depth of 20 to 40 inches. They are on side slopes. These included soils make up about 15 percent of the unit.

Permeability is rapid, surface runoff is medium, and available water capacity is low.

Most areas of this soil are used as rangeland or for hay and pasture. This soil is generally not suited to corn, flax, and small grain. It is best suited to rangeland. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. A very severe hazard of soil blowing exists where the plant cover is overgrazed. A cover of range plants is effective in controlling erosion. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Lihen soil is poorly suited to the trees and shrubs grown as windbreaks and environmental plantings. Careful site selection, the soil's lying fallow the year preceding planting, site preparation, and controlling competitive vegetation are important to the success of the planting.

This soil is suited to sites for buildings. Buildings should be designed to conform to the natural slope of the land. Land shaping may be needed in some areas. This soil is poorly suited to septic tank absorption fields because of rapid permeability. Effluent from septic tank absorption fields may not be adequately filtered by the soil and, as a result, may contaminate ground water.

This soil is in capability subclass VIe.

45B—Ruso sandy loam, 1 to 6 percent slopes. This deep, nearly level and gently sloping soil is well drained. It is on terraces. This soil is moderately deep over sand and gravel. Individual areas are irregular in shape and range from 10 acres to more than 50 acres in size.

Typically, the surface layer is sandy loam about 10 inches thick. It is dark grayish brown in the upper part and dark brown in the lower part. The subsoil is brown sandy loam about 11 inches thick. The substratum to a depth of 60 inches is light brownish gray coarse sandy loam in the upper part and light gray gravelly sand in the lower part. In some places the soil has more clay, and in other places the soil is fine sandy loam throughout.

Included with this soil in mapping are small areas of Daglum, Wabek, and Baahish soils. Daglum soils have a dense, sodic subsoil. They are in swales. Wabek soils have a surface layer of gravelly loam, and they are on knobs. Baahish soils have a very gravelly substratum at a depth of 13 inches. They are on side slopes. These included soils make up about 15 percent of the unit.

Permeability is moderately rapid in the surface layer and subsoil and very rapid in the substratum. Surface runoff is slow. Available water capacity is low. Rooting depth is somewhat restricted by gravelly sand at a depth of about 26 inches. The surface layer is friable and easily tilled throughout a wide range in moisture content.

Most areas of this soil are used for cultivated crops. The soil is suited to corn, flax, and small grain and well suited to grasses and legumes for hay and pasture. There is a severe hazard of soil blowing and a moderate hazard of water erosion. Tillage that leaves large amounts of crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility, increases water infiltration, and increases water holding capacity.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Ruso soil is suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation and controlling competitive vegetation are important to the success of the planting.

This soil is well suited to sites for buildings. It is poorly suited to septic tank absorption fields because of very

rapid permeability. Effluent from septic tank absorption fields may not be adequately filtered by the soil, and, as a result, it may contaminate ground water.

This soil is in capability subclass IIIe.

45C—Ruso sandy loam, 6 to 9 percent slopes. This deep, moderately sloping soil is well drained. It is on terraces. This soil is moderately deep over sand and gravel. Individual areas are irregular in shape and range from 10 acres to more than 50 acres in size.

Typically, the surface layer is sandy loam about 10 inches thick. It is dark grayish brown in the upper part and dark brown in the lower part. The subsoil is brown sandy loam about 11 inches thick. The substratum to a depth of 60 inches is light brownish gray coarse sandy loam in the upper part and light gray gravelly sand in the lower part. In some places the soil has more clay, and in other places the soil is fine sandy loam throughout.

Included with this soil in mapping are small areas of Daglum, Wabek, and Baahish soils. Daglum soils have a dense, sodic subsoil. They are in swales. Wabek soils have a surface layer of gravelly loam. They are on knobs. Baahish soils have a very gravelly substratum at a depth of 13 inches. They are on side slopes. These included soils make up about 15 percent of the unit.

Permeability is moderately rapid in the surface and subsoil and very rapid in the substratum. Surface runoff is medium. Available water capacity is low. Rooting depth is somewhat restricted by gravelly sand at a depth of about 26 inches. The surface layer is friable and easily tilled throughout a wide range in moisture content.

Most areas of this soil are used for pasture and hay, or as rangeland. This soil is poorly suited to corn, flax, and small grain and is well suited to grasses and legumes for hay and pasture. There is a severe hazard of soil blowing and water erosion. Tillage practices that leave large amounts of crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility, increase water infiltration, and increase water holding capacity.

A cover of range, pasture, or hay plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Ruso soil is poorly suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation and controlling competitive vegetation are important to the success of the planting.

This soil is well suited to sites for buildings. It is poorly suited to septic tank absorption fields because of the very rapid permeability. Effluent from septic tank absorption fields may not be adequately filtered by the soil, and as a result it may contaminate ground water.

This soil is in capability subclass IVe.

46—Bowdle loam, 1 to 3 percent slopes. This deep, well drained soil is nearly level. It is on terraces. It is moderately deep over sand and gravel. Individual areas are irregular in shape and range from 5 acres to about 100 acres in size.

Typically, the surface layer is dark grayish brown loam about 10 inches thick. The subsoil is loam about 19 inches thick. It is dark brown in the upper part and dark grayish brown in the lower part. The substratum is dark brown very gravelly sand to a depth of 60 inches. In some places the surface layer is sandy loam, and in other places it is gravelly loam.

Included with this soil in mapping are small areas of Arnegard, Daglum, and Shambo soils. Daglum soils have a dense, sodic subsoil. They are in swales. Arnegard and Shambo soils do not have sand and gravel within a depth of 60 inches as this Bowdle soil does. Arnegard soils are in swales. These included soils make up about 15 percent of the unit.

Permeability is moderate in the surface layer and subsoil and rapid in the substratum. Surface runoff is slow. Available water capacity is moderate. Rooting depth is somewhat restricted by very gravelly sand at a depth of about 29 inches. The surface layer is friable and easily tilled throughout a wide range in moisture content.

Most areas of this soil are used for cultivated crops, but some are used for hay and pasture. This soil is suited to such crops as small grain, corn, and flax and to grasses and legumes for pasture and hay. There is a slight hazard of soil blowing and water erosion. Tillage practices that leave crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic materials into the plow layer helps improve fertility, increase water infiltration, and increase water holding capacity.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Bowdle soil is suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation and controlling competitive vegetation are important to the success of the planting.

This soil is well suited to sites for buildings. It is poorly suited to septic tank absorption fields because of rapid permeability. Effluent from septic tank absorption fields may not be adequately filtered by the soil, and, as a result, it may contaminate ground water.

This soil is in capability subclass IIIs.

46B—Bowdle loam, 3 to 6 percent slopes. This deep, well drained soil is gently sloping. It is on terraces. It is moderately deep over sand and gravel. Individual areas are irregular in shape and range from 5 acres to more than 50 acres in size.

Typically, the surface layer is dark grayish brown loam about 10 inches thick. The subsoil is loam about 19 inches thick. It is dark brown in the upper part and dark grayish brown in the lower part. The substratum is dark brown very gravelly sand to a depth of 60 inches. In some places the surface layer is sandy loam, and in other places it is gravelly loam.

Included with this soil in mapping are small areas of Arnegard, Daglum, and Shambo soils. Daglum soils have a dense, sodic subsoil. They are in swales. Arnegard and Shambo soils do not have sand and gravel within a depth of 60 inches as the Bowdle soil does. Arnegard soils are in swales. These included soils make up about 15 percent of the unit.

Permeability is moderate in the surface layer and subsoil and rapid in the substratum. Surface runoff is medium. Available water capacity is moderate. Rooting depth is somewhat restricted by very gravelly sand at a depth of about 29 inches. The surface layer is friable and easily tilled throughout a wide range in moisture content.

Most areas of this soil are used for cultivated crops, but some are used for hay and pasture. This soil is suited to growing such crops as small grain, corn, and flax and to grasses and legumes for pasture and hay. There is a slight hazard of soil blowing and a moderate hazard of water erosion. Tillage that leaves a moderate amount of crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic materials into the plow layer helps improve fertility, increase water infiltration, and increase moisture holding capacity.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Bowdle soil is suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation and controlling competitive vegetation are important to the success of the planting.

This soil is well suited to sites for buildings. It is poorly suited to septic tank absorption fields because of rapid permeability. Effluent from septic tank absorption fields may not be adequately filtered by the soil, and as a result it may contaminate ground water.

This soil is in capability subclass IIIe.

47—Moreau silty clay, 1 to 3 percent slopes. This moderately deep, nearly level soil is well drained. It is on foot slopes and side slopes of uplands. Individual areas are irregular in shape and range from 10 acres to more than 100 acres in size.

Typically, the surface layer is grayish brown silty clay about 7 inches thick. The subsoil is grayish brown silty clay about 18 inches thick. The substratum is grayish brown silty clay to a depth of 32 inches. Below this is soft bedrock. In some places the surface layer is silty clay loam, and in other places bedrock is at a depth of 40 to 60 inches.

Included with this soil in mapping are small areas of Daglum and Rhoades soils in swales. The soils have a dense, sodic subsoil. These included soils make up about 15 percent of the unit.

Permeability is slow, surface runoff is slow, and available water capacity is low. Root penetration is somewhat restricted by soft bedrock at a depth of about 32 inches.

Most areas of this soil are used for cultivated crops. This soil is suited to corn, flax, small grain, and grasses and legumes for pasture and hay. There is a moderate hazard of soil blowing and a slight hazard of water erosion. Tillage that leaves large amounts of crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility and increase water infiltration. The surface layer tends to form hard clods and a crust, which inhibits seedling emergence if the soil is tilled when too wet or too dry. Tilth can be maintained or improved by cultivation when the soil is neither too dry or too wet.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Moreau soil is suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation and controlling competitive vegetation are important to the success of the planting.

This soil is poorly suited to sites for buildings and to septic tank absorption fields. The shrinking and swelling of the soil is a limitation to sites for buildings. This can be overcome by providing good surface drainage by grading the surface away from the building and by using reinforced footings and basement walls. Slow permeability and the depth to bedrock limit this soil for septic tank absorption fields. These limitations are difficult to overcome. Alternative systems to onsite disposal, such as holding tanks and safe disposal of the effluent, should be considered. Effluent from septic tank absorption fields can follow bedding planes in the

bedrock and can surface downslope or can contaminate ground water.

This soil is in capability subclass IIIs.

47B—Moreau silty clay, 3 to 6 percent slopes. This moderately deep, gently sloping soil is well drained. It is on side slopes and foot slopes of uplands. Individual areas are irregular in shape and range from 10 acres to more than 100 acres in size.

Typically, the surface layer is grayish brown silty clay about 7 inches thick. The subsoil is grayish brown silty clay about 18 inches thick. The substratum is grayish brown silty clay to a depth of 32 inches. Below this is soft bedrock. In some places the surface layer is silty clay loam and in other places bedrock is at a depth of 40 to 60 inches.

Included with this soil in mapping are small areas of Daglum and Rhoades soils in swales. The soils have a dense, sodic subsoil. These included soils make up about 15 percent of the unit.

Permeability is slow, surface runoff is medium, and available water capacity is low. Root penetration is somewhat restricted by soft bedrock at a depth of about 32 inches.

Most areas of this soil are used for cultivated crops and as rangeland. This soil is suited to corn, flax, small grain, and grasses and legumes for pasture and hay. There is a moderate hazard of soil blowing and water erosion. Tillage practices that leave large amounts of crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility and increase water infiltration. The surface layer tends to form a crust and hard clods if tilled when the soil is too wet or too dry. Tilth can be maintained or improved by cultivation when the soil is neither too dry or too wet.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Moreau soil is suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation and controlling competitive vegetation are important to the success of the planting.

This soil is poorly suited to sites for buildings and to septic tank absorption fields. The low strength is a limitation for buildings. This can be overcome by providing good surface drainage by grading the surface away from the buildings and by using reinforced footings and basement walls. The slow permeability and depth to bedrock are limitations for septic tank absorption fields. These limitations are difficult to overcome. Alternative systems to onsite disposal, such as holding tanks and safe disposal of the effluent, should be considered. Effluent from septic tank absorption fields can follow bedding planes in the bedrock and can surface downslope or can contaminate ground water.

This soil is in capability subclass IIIe.

47C—Moreau silty clay, 6 to 9 percent slopes. This moderately deep, moderately sloping soil is well drained. It is on side slopes and foot slopes of uplands. Individual areas are irregular in shape and range from 10 acres to more than 100 acres in size.

Typically, the surface layer is grayish brown silty clay about 7 inches thick. The subsoil is grayish brown silty clay about 18 inches thick. The substratum is grayish brown silty clay to a depth of 32 inches. Below this is soft bedrock. In some places the surface layer is silty clay loam, and in other places bedrock is at a depth of 40 to 60 inches.

Included with this soil in mapping are small areas of Daglum, Rhoades, and Wayden soils. Daglum and Rhoades soils have a dense, sodic subsoil. They are in swales. Wayden soils have soft bedrock at a depth of 20 inches or less. They are on ridges. These included soils make up about 15 percent of the unit.

Permeability is slow, surface runoff is medium, and available water capacity is low. Root penetration is somewhat restricted by soft bedrock at a depth of about 32 inches.

Most areas of this soil are used as rangeland or for hay and cultivated crops. This soil is poorly suited to corn, flax, and small grain but is suited to grasses and legumes for pasture and hay. There is a moderate hazard of soil blowing and a severe hazard of water erosion. Tillage that leaves large amounts of crop residue on the surface, field windbreaks, contour stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility and increase water infiltration. The surface layer tends to form a crust and large clods if tilled when too wet or too dry. Tilth can be maintained or improved by cultivation when the soil is neither too wet or too dry.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Moreau soil is suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation and controlling competitive vegetation are important to the success of the planting.

This soil is poorly suited to sites for buildings and to septic tank absorption fields. The shrinking and swelling of this soil is a limitation to sites for buildings. This can be overcome by providing good surface drainage by

grading the surface away from the building and by using reinforced footings and basement walls. The slow permeability and depth to bedrock limit the use of this soil for septic tank absorption fields. These limitations are difficult to overcome. Alternative systems to onsite disposal, such as holding tanks and safe disposal of the effluent, should be considered. Effluent from septic tank filter fields can follow bedding planes in the bedrock and can surface downslope or can contaminate ground water.

This soil is in capability subclass IVe.

48B—Temvik silt loam, 3 to 6 percent slopes. This deep, gently sloping soil is well drained. It is on uplands. Individual areas are irregular in shape and range from 5 acres to more than 100 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 6 inches thick. The subsoil is silt loam about 28 inches thick. It is dark brown in the upper part, light yellowish brown in the middle part, and light brownish gray in the lower part. The substratum is light brownish gray clay loam to a depth of 60 inches. In some places the surface layer is loam, in other places it is fine sandy loam, and in a few places it is dark colored to a greater depth.

Included with this soil in mapping are small areas of Sen and Noonan soils. Sen soils have bedrock at a depth of 20 to 40 inches. They are on side slopes. Noonan soils have a dense, sodic subsoil. They are in slight depressions. These included soils make up about 10 percent of the unit.

Permeability is moderately slow, surface runoff is medium, and available water capacity is high. The surface layer is friable and easily tilled throughout a wide range in moisture content.

Most areas of this soil are used for cultivated crops. This soil is well suited to corn, flax, small grain, and grasses and legumes for pasture and hay. There is a slight hazard of soil blowing and a moderate hazard of water erosion. Tillage that leaves moderate amounts of crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility and increase water infiltration.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Temvik soil is well suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation and controlling competitive vegetation are important to the success of the planting.

This soil is suited to sites for buildings and is poorly suited to septic tank absorption fields. The shrinking and swelling of this soil is a limitation to sites for buildings. This can be overcome by using reinforced footings and basement walls and by providing good surface drainage by grading the surface away from the building. The moderately slow permeability limits the use of this soil for septic tank absorption fields. It can be overcome by enlarging the absorption field.

This soil is in capability subclass IIe.

49—Morton silt loam, 1 to 3 percent slopes. This moderately deep, nearly level soil is well drained. It is on side slopes of uplands. Individual areas are irregular in shape and range from 5 acres to about 50 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 5 inches thick. The subsoil is silt loam about 22 inches thick. It is dark yellowish brown in the upper part and light yellowish brown in the lower part. The substratum is light olive gray silt loam to a depth of 37 inches. Below this is soft bedrock. In some places the soil has a surface layer of silty clay loam, in other places it contains more sand, and in a few places it has bedrock at a depth of more than 40 inches.

Included with this soil in mapping are small areas of Belfield and Rhoades soils in swales. The soils have a dense, sodic subsoil. These included soils make up about 10 percent of the unit.

Permeability is moderate, surface runoff is slow, and available water capacity is moderate. Root penetration is somewhat restricted by soft bedrock at a depth of about 37 inches. The surface layer is friable and easily tilled throughout a wide range in moisture content.

Most areas of this soil are used for cultivated crops. This soil is well suited to corn, flax, small grain, and grasses and legumes for pasture and hay. There is a slight hazard of soil blowing and water erosion. Tillage that leaves crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility and increase water infiltration.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Morton soil is well suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation and controlling competitive vegetation are important to the success of the planting.

This soil is suited to sites for buildings and is poorly suited to septic tank absorption fields. The bedrock is a limitation to sites for buildings but can be overcome because it is soft and easily excavated. The shrinking

and swelling of the soil is a limitation to sites for buildings. This can be overcome by providing good surface drainage by grading the surface away from the building and by using reinforced footings and basement walls. The depth to bedrock limits the use of this soil for septic tank absorption fields. It is difficult to overcome for this use. Alternative systems to onsite waste disposal, such as holding tanks, should be considered. Effluent from septic tank absorption fields can follow bedding planes in the bedrock and can surface downslope or can contaminate ground water.

This soil is in capability subclass IIc.

49B—Morton silt loam, 3 to 6 percent slopes. This moderately deep, gently sloping soil is well drained. It is on side slopes of uplands. Individual areas are irregular in shape and range from 5 acres to about 100 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 5 inches thick. The subsoil is silt loam about 22 inches thick. It is dark yellowish brown in the upper part and light yellowish brown in the lower part. The substratum is light olive gray silt loam to a depth of 37 inches. Below this is soft bedrock. In some places the surface layer is silty clay loam, or it is more than 16 inches thick. In other places the soil has more sand. In a few places bedrock is at a depth of more than 40 inches.

Included with this soil in mapping are small areas of Belfield and Rhoades soils in swales. The soils have a dense, sodic subsoil. These included soils make up about 10 percent of the unit.

Permeability is moderate, surface runoff is medium, and available water capacity is moderate. Root penetration is somewhat restricted by soft bedrock at a depth of about 37 inches. The surface layer is friable and easily tilled throughout a wide range in moisture content.

Most areas of this soil are used for cultivated crops. This soil is well suited to corn, flax, small grain, and grasses and legumes for pasture and hay. There is a slight hazard of soil blowing and moderate hazard of water erosion. Tillage that leaves moderate amounts of crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility and increase water infiltration.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Morton soil is well suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation and controlling competitive vegetation are important to the success of the planting.

This soil is suited to sites for buildings and is poorly suited to septic tank absorption fields. The depth to bedrock is a limitation to sites for buildings. This limitation can be overcome because the rock is soft and easily excavated. The shrinking and swelling of the soil also limits construction of buildings. This can be overcome by providing good surface drainage by grading the surface away from the building and using reinforced footings and basement walls. The depth to bedrock limits the use of this soil for septic tank absorption fields. It is difficult to overcome for this use. Alternative systems to onsite waste disposal, such as holding tanks, should be considered. Effluent from septic tank absorption fields can follow bedding planes in the bedrock and can surface downslope or can contaminate ground water.

This soil is in capability subclass IIe.

49C—Morton silt loam, 6 to 9 percent slopes. This moderately deep, moderately sloping soil is well drained. It is on side slopes of uplands. Individual areas of this soil are irregular in shape and range from 5 acres to about 50 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 5 inches thick. The subsoil is silt loam about 22 inches thick. It is dark yellowish brown in the upper part and light yellowish brown in the lower part. The substratum is light olive gray silt loam to a depth of 37 inches. Below this is soft bedrock. In some places the surface layer is silty clay loam, and in a few places it is dark colored and more than 16 inches thick. In some places the soil has more sand. In other places bedrock is at a depth of more than 40 inches.

Included with this soil in mapping are small areas of Belfield, Cabba, and Rhoades soils. Belfield and Rhoades soils are in swales and have a dense, sodic subsoil. Cabba soils have soft bedrock at a depth of 20 inches or less. They are on ridges and hills. These included soils make up about 10 percent of the unit.

Permeability is moderate, surface runoff is medium, and available water capacity is moderate. Root penetration is somewhat restricted by soft bedrock at a depth of about 37 inches. The surface layer is friable and easily tilled throughout a wide range in moisture content.

Most areas of this soil are used for cultivated crops. This soil is suited to corn, flax, small grain, and grasses and legumes for pasture and hay. There is a slight hazard of soil blowing and a severe hazard of water erosion. Tillage that leaves large amounts of crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility and increase water infiltration.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Morton soil is well suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation and controlling competitive vegetation are important to the success of the planting.

This soil is suited to sites for buildings and is poorly suited to septic tank absorption fields. The depth to bedrock is a limitation to sites for buildings, but can be overcome because the rock is soft and easily excavated. The shrinking and swelling of the soil also is a limitation for construction of buildings. This can be overcome by providing good surface drainage by grading the surface away from the building and by using reinforced footings and basement walls. The depth to bedrock limits the use of this soil for septic tank absorption fields. It is difficult to overcome for this use. Alternative systems to onsite disposal should be considered. Effluent from septic tank absorption fields can follow bedding planes in the bedrock and can surface downslope or can contaminate ground water.

This soil is in capability subclass IIIe.

51C—Amor extremely stony loam, 1 to 9 percent slopes. This moderately deep, nearly level to moderately sloping soil is well drained. It is on side slopes and foot slopes of uplands. Individual areas of this unit range from about 5 acres to several hundred acres in size. About 3 to 15 percent of the surface is covered with stones.

Typically, the surface layer is dark grayish brown loam about 7 inches thick. The subsoil is very fine sandy loam about 14 inches thick. It is dark brown in the upper part and brown in the lower part. The substratum is light brownish gray loam to a depth of about 34 inches. Below this is soft bedrock. In some places the surface layer is silt loam or the subsoil is clay loam. In other places the soil has bedrock at a depth of more than 40 inches, and in a few places it has some coarse fragments.

Included with this soil in mapping are small areas of Arnegard, Belfield, Cabba, Grail, Rhoades, and Vebar soils. Arnegard, Belfield, and Grail soils are deep. They do not have stones on the surface as this Amor soil does. Rhoades soils have a dense, sodic subsoil. These soils are in swales. Cabba soils have bedrock at a depth of 20 inches or less. They are on hills and ridges. Vebar soils have more sand. They are on side slopes. These included soils make up about 20 percent of the unit.

Permeability is moderate, surface runoff is medium, and available water capacity is moderate. Root penetration is somewhat restricted by soft bedrock at a depth of 34 inches.

Most areas of this soil are used as rangeland and are better suited to this use and to wildlife habitat. This soil is generally not suited to the trees and shrubs grown as windbreaks and environmental plantings; to such crops as corn, flax, and small grain; or to grasses and legumes for pasture and hay. It is limited for these uses by the stony surface. A cover of range plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This soil is suited to sites for buildings and is poorly suited to septic tank absorption fields. The depth to bedrock is a limitation for construction of buildings but can be overcome because the rock is soft and easily excavated. The shrinking and swelling is also a limitation to sites for buildings. This can be overcome by providing good surface drainage by grading the surface away from the building and by using reinforced footings and basement walls. The depth to bedrock also limits the use of this soil for septic tank absorption fields. It is difficult to overcome for this use. Alternative systems to onsite waste disposal should be considered. Effluent from septic tank absorption fields can follow bedding planes in the bedrock and can surface downslope or can contaminate ground water.

This soil is in capability subclass VIIs.

52B—Morton-Rhoades silt loams, 1 to 6 percent slopes. These moderately deep and deep, nearly level and gently sloping soils are well drained and moderately well drained. They are on uplands. Individual areas are irregular in shape and range from 5 acres to about 100 acres in size. They are made up of about 55 percent Morton soils and 30 percent Rhoades soils. The Morton soil is on convex side slopes, and the Rhoades soil is on concave side slopes and in swales. These soils are so intricately mixed or so small in size that it is not practical to separate them in mapping.

Typically, the Morton soil has a surface layer of dark grayish brown silt loam about 5 inches thick. The subsoil is silt loam about 22 inches thick. It is dark yellowish brown in the upper part and light yellowish brown in the lower part. The substratum is light olive gray silt loam to a depth of 37 inches. Below this is soft bedrock. In some places the soil has a surface layer of silty clay loam or loam.

Typically, the Rhoades soil has a surface layer of grayish brown silt loam about 3 inches thick. The subsoil is dark grayish brown silty clay loam about 7 inches thick. The substratum to a depth of 59 inches is grayish brown silty clay in the upper part and light olive brown clay in the lower part. Below this is soft bedrock. In some places the soil has a thicker surface layer.

Included with these soils in mapping are small areas of Belfield, Farland, Grail, and Savage soils. The soils have

a thicker surface layer and are more than 60 inches deep to bedrock. Belfield and Grail soils are in swales. Farland soils are on terraces, and Savage soils are on foot slopes. These included soils make up about 15 percent of the unit.

Permeability is moderate in the Morton soil and very slow in the Rhoades soil. Surface runoff is medium in both soils, and available water capacity is moderate. Root penetration is somewhat restricted by soft bedrock at a depth of about 37 inches in the Morton soil and is restricted by the dense subsoil at a depth of about 3 inches in the Rhoades soil.

Most areas of this unit are used for cultivated crops. These soils are suited to corn, flax, small grain, and grasses and legumes for pasture and hay. There is a slight hazard of soil blowing and a moderate hazard of water erosion. Tillage that loosens the dense, sodic subsoil of the Rhoades soil or growing deep rooted crops, such as alfalfa or sweetclover, allows moisture and root penetration. Avoiding tillage of these soils when they are wet reduces crusting and the formation of hard clods that make a poor seedbed. Tillage that leaves a moderate amount of crop residue on the surface, stripcropping, and grassed waterways help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility and soil tilth.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking or overgrazing the range reduces the protective vegetative cover and causes deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

The Morton soil in this unit is well suited to the trees and shrubs grown as windbreaks and environmental plantings. The Rhoades soil is generally not suited to these uses. Root penetration is restricted in the Rhoades soils. Site selection, site preparation, the soil's lying fallow the year preceding planting, and controlling competitive vegetation are important to the success of the planting.

The Morton soil is suited to sites for buildings and is poorly suited to septic tank absorption fields. The Rhoades soil is poorly suited to sites for buildings and generally is not suited to septic tank absorption fields. The depth to bedrock limits the Morton soil for septic tank absorption fields. This limitation is difficult to overcome. Alternative systems of waste disposal, such as holding tanks, should be considered. Effluent from septic tanks can follow bedding planes in the bedrock and can surface downslope or can contaminate ground water. The shrinking and swelling in both soils is a limitation to sites for buildings. This can be overcome by providing good surface drainage by grading the surface away from the buildings and using reinforced footings and basement walls. The depth to rock is a limitation for the construction of buildings, however, it can be overcome because the rock is soft and easily excavated.

This unit is in capability subclass IIIe.

52C—Morton-Rhoades silt loams, 6 to 9 percent slopes. These moderately deep and deep, moderately sloping soils are well drained and moderately well drained. They are on uplands. Individual areas are irregular in shape and range from 5 acres to more than 50 acres in size. They are made up of about 55 percent Morton soils and 30 percent Rhoades soils. The Morton soil is on convex side slopes, and the Rhoades soil is on concave side slopes and in swales. These soils are so intricately mixed or so small in size that it is not practical to separate them in mapping.

Typically, the Morton soil has a surface layer of dark grayish brown silt loam about 5 inches thick. The subsoil is silt loam about 22 inches thick. It is dark yellowish brown in the upper part and light yellowish brown in the lower part. The substratum is light olive gray silt loam to a depth of 37 inches. Below this is soft bedrock. In some places the soil has a surface layer of silty clay loam or loam.

Typically, the Rhoades soil has a surface layer of grayish brown silt loam about 3 inches thick. The subsoil is dark grayish brown silty clay loam about 7 inches thick. The substratum to a depth of 59 inches is grayish brown silty clay in the upper part and light olive brown clay in the lower part. Below this is soft bedrock. In some places the soil has a thicker surface layer.

Included with these soils in mapping are small areas of Belfield, Cabba, Farland, Grail, and Savage soils. Belfield, Farland, Grail, and Savage soils have a thicker surface layer. Cabba soils have soft bedrock at a depth of 20 inches or less. Belfield and Grail soils are in swales, Farland soils are on terraces, Savage soils are on foot slopes, and Cabba soils are on hills and ridges. These included soils make up about 15 percent of the unit.

Permeability is moderate in the Morton soil and very slow in the Rhoades soil. Surface runoff is medium for both soils, and available water capacity is moderate. Root penetration is somewhat restricted by soft bedrock at a depth of about 37 inches in the Morton soil and is restricted by the dense subsoil at 3 inches in the Rhoades soil.

Many areas of this unit are used for cultivated crops, and some areas are used for hay, range, or pasture. These soils are poorly suited to such crops as corn, flax, and small grain. They are better suited to grasses and legumes for pasture and hay. There is a slight hazard of soil blowing and a severe hazard of water erosion. Tillage that loosens the dense, sodic subsoil of the Rhoades soil or growing deep rooted crops, such as alfalfa or sweetclover, allows root and moisture penetration. Avoiding tillage when these soils are wet reduces crusting and the formation of hard clods that

provide a poor seedbed. Tillage that leaves large amounts of crop residue on the surface, stripcropping, and grassed waterways help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve tilth in the Rhoades soil and maintain or improve fertility.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking or overgrazing the range reduces the protective vegetative cover and causes deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

The Morton soil in this unit is well suited to the trees and shrubs grown as windbreaks and environmental plantings. The Rhoades soil is generally not suited to these uses. Root penetration is restricted in the Rhoades soil. Site selection, the soil's lying fallow the year preceding planting, site preparation, and controlling competitive vegetation are important to the success of the planting.

The Morton soil is suited to sites for buildings and is poorly suited to septic tank absorption fields. The Rhoades soil is poorly suited to sites for buildings and is generally not suited to septic tank absorption fields. The depth to bedrock limits the use of these soils for septic tank absorption fields. This limitation is difficult to overcome. Alternative systems to onsite disposal, such as holding tanks, should be considered. Effluent from septic tank absorption fields can follow bedding planes in the bedrock and can surface downslope or can contaminate ground water. The shrinking and swelling of both soils is a limitation to sites for buildings. This can be overcome by the use of reinforced footings and basement walls and by providing good surface drainage by grading the surface away from the building.

This unit is in capability subclass IVe.

53B—Watrous loam, 1 to 6 percent slopes. This moderately deep, nearly level and gently sloping soil is well drained. It is on uplands. Individual areas are irregular in shape and range from 5 acres to about 50 acres in size.

Typically, the surface layer is dark grayish brown and dark brown loam about 7 inches thick. The subsoil is about 17 inches thick. It is brown clay loam in the upper part and grayish brown loam in the lower part. The substratum is light gray loam to a depth of about 27 inches. Below this is hard sandstone. In some places the soil is shallow to hard bedrock; in other places it is underlain by soft bedrock. In a few places the subsoil is loamy fine sand or fine sandy loam.

Included with this soil in mapping are small areas of Baahish and Cabba soils. Baahish soils are shallow over limestone gravel. They are on side slopes. Cabba soils are lighter colored and are shallow to soft bedrock. They are on ridges and hills. These included soils make up about 10 percent of the unit.

Permeability is moderate, surface runoff is medium, and available water capacity is low. Root penetration is restricted by hard bedrock at a depth of about 27 inches. The surface layer is friable and easily tilled throughout a wide range in moisture content.

Some areas of this soil are used for cultivated crops. This soil is suited to corn, flax, small grain, and grasses and legumes for pasture and hay. There is a slight hazard of soil blowing and a moderate hazard of water erosion. Tillage that leaves moderate amounts of crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility, maintain soil tilth, and increase water infiltration.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Watrous soil is suited to the trees and shrubs grown as windbreaks and environmental plantings. The hard bedrock limits rooting depth, and only selected climatically adapted trees and shrubs should be planted. Careful site selection, preparation, and controlling competitive vegetation are important to the success of the planting.

This soil is suited to sites for buildings and is generally not suited to septic tank absorption fields. The bedrock is a limitation to sites for buildings. It can be overcome by removing the rock or by raising the grade by adding fill material. The bedrock also limits the use of this soil for septic tank absorption fields and is difficult to overcome for this use. Alternative systems to onsite disposal, such as holding tanks, should be considered. Effluent from septic tank absorption fields can follow bedding planes or fractures in the bedrock and can surface downslope or can contaminate ground water.

This soil is in capability subclass IIIe.

54B—Parshall fine sandy loam, 1 to 6 percent slopes. This deep, nearly level and gently sloping soil is well drained. It is on terraces, on foot slopes, and in swales on uplands. Individual areas are irregular in shape and range from 5 acres to about 100 acres in size.

Typically, the surface layer is dark grayish brown fine sandy loam about 15 inches thick. The subsoil is dark grayish brown fine sandy loam about 12 inches thick. The substratum is fine sandy loam to a depth of 60 inches. It is brown in the upper part, yellowish brown in the middle part, and light olive brown in the lower part. In

some places the surface layer is loam, and in other places it is less than 15 inches thick.

Included with this soil in mapping are small areas of Lihen, Ruso, and Vebar soils. Lihen soils have a surface layer of loamy fine sand. They are on low ridges. Ruso soils have gravel in the substratum. Vebar soils have soft bedrock at a depth of 20 to 40 inches. They are on side slopes. These included soils make up about 10 percent of the unit.

Permeability is moderately rapid, surface runoff is slow, and available water capacity is moderate. The surface layer is friable and easily tilled throughout a wide range in moisture content.

Most areas of this soil are used for cultivated crops. This soil is well suited to corn, flax, small grain, and grasses and legumes for pasture and hay. There is a severe hazard of soil blowing and a moderate hazard of water erosion. Tillage that leaves large amounts of crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Minimizing summer fallow and using cover crops help prevent soil blowing. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility, maintain soil tilth, and increase water infiltration.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Parshall soil is well suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation, the soil's lying fallow the year preceding planting, and controlling competitive vegetation are important to the success of the planting.

This soil is well suited to sites for buildings and to septic tank absorption fields.

This soil is in capability subclass IIIe.

55—Pits. This unit is in areas from which the overlying soil material has been removed in order to mine sand; gravel; large porcelanite fragments, locally called "scoria" or "clinkers"; or coal. In some places where coal has been mined underground, this unit contains mine sinks formed from the caving in of underground mine shafts. Areas of this unit are irregular in shape and range from 5 acres to about 35 acres in size.

Included with this unit in mapping are small areas of Bowdle, Brandenburg, Hidatsa, Ruso, Searing, and Wabek soils. These soils have gravel or porcelanite at shallow to moderate depths. These included soils make up about 15 percent of the unit.

The vertical walls of the pits are generally unstable and may be subject to slippage and slides. Underground mines may continue to cave in. Abandoned pits are idle or are used for wildlife habitat or stock water ponds. Water seeps out of the very permeable sand, gravel, scoria, or coal and forms ponds in some mine sinks. Pits are generally not suited to cultivated crops, hay, pasture, and the trees and shrubs grown as windbreaks and environmental plantings. They also cannot be used for buildings and sanitary facilities. Hand planting of trees provides cover for livestock and habitat for wildlife. Smoothing the surface of the pit, replacing topsoil, adding manure or other organic matter help to prevent erosion and help to increase the suitability for most uses that require the growth of plants.

This unit is not assigned to a capability subclass.

58—Regent silty clay loam, 1 to 3 percent slopes. This moderately deep, nearly level soil is well drained. It is on side slopes of uplands. Individual areas are irregular in shape and range from 5 acres to about 50 acres in size.

Typically, the surface layer is grayish brown silty clay loam about 8 inches thick. The subsoil is about 25 inches thick. It is grayish brown silty clay in the upper part, light brownish gray silty clay in the middle part, and light olive gray silty clay loam in the lower part. Below this is soft bedrock. In some places the surface layer is calcareous silty clay, and in other places it is silt loam.

Included with this soil in mapping are small areas of Grail, Rhoades, and Savage soils. Grail and Savage soils are deep. Rhoades soils have a dense, sodic subsoil. Grail and Rhoades soils are in swales, and Savage soils are on foot slopes. These included soils make up about 15 percent of the unit.

Permeability and surface runoff are slow, and available water capacity is moderate. This soil is sticky when wet, which makes tillage somewhat difficult. Root penetration is restricted by soft bedrock at a depth of about 33 inches.

Most areas of this soil are used for cultivated crops. This soil is well suited to corn, flax, small grain, and grasses and legumes for pasture or hay. There is a slight hazard of soil blowing and water erosion. Tillage that leaves crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer help improve fertility, improve or maintain soil tilth, and increase water infiltration. Avoiding tillage when this soil is wet helps prevent the formation of hard clods that provide a poor seedbed.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Regent soil is suited to the trees and shrubs grown as windbreaks and environmental plantings. Site

preparation and controlling competitive vegetation are important to the success of the planting.

This soil is suited to sites for buildings and is poorly suited to septic tank absorption fields. The shrinking and swelling of the soil is a limitation to sites for buildings. This can be overcome by the use of reinforced footings and basement walls and by providing good surface drainage by grading the surface away from the building. The slow permeability and depth to bedrock limit the use of this soil for septic tank absorption fields. These limitations are difficult to overcome. Alternative systems to onsite waste disposal, such as holding tanks, should be considered. Effluent from septic tank absorption fields can follow bedding planes in the bedrock and can surface downslope or can contaminate ground water.

This soil is in capability subclass IIc.

58B—Regent silty clay loam, 3 to 6 percent slopes. This moderately deep, gently sloping soil is well drained. It is on side slopes of uplands. Individual areas are irregular in shape and range from 5 acres to more than 100 acres in size.

Typically, the surface layer is grayish brown silty clay loam about 8 inches thick. The subsoil is about 25 inches thick. It is grayish brown silty clay in the upper part, light brownish gray silty clay in the middle part, and light olive gray silty clay loam in the lower part. Below this is soft bedrock. In some places the surface layer is calcareous silty clay, and in other places the surface layer is silt loam.

Included with this soil in mapping are small areas of Grail, Rhoades, and Savage soils. Grail and Savage soils are deep. Rhoades soils have a dense, sodic subsoil. Grail and Rhoades soils are in swales, and Savage soils are on foot slopes. These included soils make up about 15 percent of the unit.

Permeability is slow, surface runoff is medium, and available water capacity is moderate. This soil is sticky when wet, which makes tillage somewhat difficult. Root penetration is restricted by soft bedrock at a depth of about 33 inches.

Most areas of this soil are used for cultivated crops. This soil is well suited to corn, flax, small grain, and grasses and legumes for pasture or hay. There is a slight hazard of soil blowing and a moderate hazard of water erosion. Tillage that leaves moderate amounts of crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Returning crop residue to the surface or adding other organic material into the plow layer helps improve fertility, maintain or improve soil tilth, and increase water infiltration. Avoiding tillage when this soil is wet helps prevent the formation of hard clods that make a poor seedbed.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Regent soil is suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation and controlling competitive vegetation are important to the success of the planting.

This soil is suited to sites for buildings and is poorly suited to septic tank absorption fields. The shrinking and swelling of this soil is a limitation to sites for buildings. This can be overcome by the use of reinforced footings and basement walls and by providing good surface drainage by grading the surface away from the building. The slow permeability and depth to bedrock limit the use of this soil for septic tank absorption fields. These limitations are difficult to overcome. Alternative systems to onsite waste disposal, such as holding tanks, should be considered. Effluent from septic tank absorption fields can follow bedding planes in the bedrock and can surface downslope or can contaminate ground water.

This soil is in capability subclass IIe.

58C—Regent silty clay loam, 6 to 9 percent slopes. This moderately deep, moderately sloping soil is well drained. It is on uplands. Individual areas are irregular in shape and range from 5 acres to more than 100 acres in size.

Typically, the surface layer is grayish brown silty clay loam about 8 inches thick. The subsoil is about 25 inches thick. It is grayish brown silty clay in the upper part, light brownish gray silty clay in the middle part, and light olive gray silty clay loam in the lower part. Below this is soft bedrock. In places the surface layer is calcareous silty clay, and in other places the surface layer is silt loam. In a few places the depth to bedrock is more than 40 inches.

Included with this soil in mapping are small areas of Cabba, Grail, and Rhoades soils. Cabba soils are shallow to soft bedrock. They are on hills and ridges. Grail soils are deep. Rhoades soils have a dense, sodic subsoil. Grail and Rhoades soils are in swales. These included soils make up about 20 percent of the unit.

Permeability is slow, surface runoff is rapid, and available water capacity is moderate. This soil is sticky when wet, which makes tillage somewhat difficult. Root penetration is restricted by soft bedrock at a depth of about 33 inches.

Many areas of this soil are used for cultivated crops, but some are used for pasture or hay or as rangeland. This soil is suited to corn, flax, small grain, and grasses and legumes for pasture or hay. There is a slight hazard of soil blowing and a serious hazard of water erosion. Tillage that leaves large amounts of crop residue on the surface, field windbreaks, contour stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer

helps improve fertility, improve or maintain soil tilth, and increase water infiltration. Avoiding tillage when this soil is wet helps prevent the formation of hard clods that make a poor seedbed.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Regent soil is suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation and controlling competitive vegetation are important to the success of the planting. If windbreaks are planted, they should be planted on the contour to reduce the hazard of erosion from melting snow.

This soil is suited to sites for buildings and is poorly suited to septic tank absorption fields. The shrinking and swelling of this soil is a limitation to sites for buildings. This can be overcome by using reinforced footings and basement walls and by providing good surface drainage by grading the surface away from the building. The slow permeability and depth to bedrock limit the use of this soil for septic tank absorption fields. These limitations are difficult to overcome. Alternative systems to onsite disposal, such as holding tanks, should be considered. Effluent from septic tank absorption fields can follow bedding planes in the bedrock and can surface downslope or can contaminate ground water.

This soil is in capability subclass IIIe.

61B—Regent-Rhoades silty clay loams, 1 to 6 percent slopes. These moderately deep and deep, nearly level and gently sloping soils are well drained and moderately well drained. They are on uplands. This unit is often dissected by many, shallow drainageways. Individual areas are irregular in shape and range from 5 acres to more than 100 acres in size. They are made up of about 55 percent Regent soils and 30 percent Rhoades soils. The Regent soil is on convex side slopes, and the Rhoades soil is on concave side slopes and in swales. These soils are so intricately mixed or so small in size that it is not practical to separate them in mapping.

Typically, the Regent soil has a surface layer of grayish brown silty clay loam about 8 inches thick. The subsoil is about 25 inches thick. It is grayish brown silty clay in the upper part, light brownish gray silty clay in the middle part, and light olive gray silty clay loam in the lower part. Below this is soft bedrock. In some places the surface layer is calcareous silty clay and in other places it is silt loam.

Typically, the Rhoades soil has a surface layer of grayish brown silty clay loam about 3 inches thick. The subsoil is dark grayish brown silty clay loam about 7 inches thick. The substratum is grayish brown silty clay to a depth of 29 inches. It is light olive brown clay to a depth of 59 inches. Below this is soft bedrock. In some places the soil has a thicker surface layer.

Included with this unit in mapping are small areas of Belfield, Farland, Grail, and Savage soils. These soils are more than 60 inches deep to bedrock. Belfield and Grail soils are in swales, Farland soils are on terraces, and Savage soils are on side slopes. Also included are small, scabby areas which are on the side slopes and which are barren of vegetation. These included soils make up about 15 percent of the unit.

Permeability is slow in the Regent soil and very slow in the Rhoades soil. Surface runoff is medium, and available water capacity is moderate in both these soils. These soils are sticky when wet, which makes tillage somewhat difficult. Root penetration is somewhat restricted by soft bedrock in the Regent soil at a depth of about 33 inches and is restricted by the sodic subsoil in the Rhoades soil at a depth of about 3 inches.

Most areas of this unit are used for cultivated crops. These soils are suited to corn, flax, small grain, and grasses and legumes for pasture and hay. There is a slight hazard of soil blowing and a moderate hazard of water erosion. Loosening the dense, sodic subsoil by tillage or by growing deep rooted crops, such as alfalfa or sweetclover, is beneficial. Avoiding tillage when these soils are wet reduces crusting and the formation of hard clods that make a poor seedbed. Use of a cropping system which minimizes summer fallow and which includes grass and legumes helps maintain or improve soil tilth and penetration of roots and moisture. Tillage that leaves moderate amounts of crop residue on the surface, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility and increase water infiltration.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking or overgrazing the range reduces the protective vegetative cover and causes deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

The Regent soil in this unit is well suited to the trees and shrubs grown as windbreaks and environmental plantings. The Rhoades soil is generally not suited to these uses. Root penetration is restricted in the Rhoades soil by the sodic subsoil. Site selection, site preparation, and controlling competitive vegetation are important to the success of the planting.

These soils are poorly suited to sites for buildings and to septic tank absorption fields. The shrinking and swelling of these soils is a limitation to sites for buildings. This can be overcome by the use of reinforced footings and basement walls and by providing good surface drainage by grading the surface away from the building. The slow permeability and depth to bedrock limit the use

of these soils for septic tank absorption fields. These limitations are difficult to overcome. Alternative systems of waste disposal to onsite disposal should be considered. Effluent can follow bedding planes in the bedrock and can surface downslope or can contaminate ground water.

This unit is in capability subclass IIIe.

61C—Regent-Rhoades silty clay loams, 6 to 9 percent slopes. These moderately deep and deep, moderately sloping soils are well drained and moderately well drained. They are on uplands. This unit is often dissected by many shallow drainageways. Individual areas are irregular in shape and range from 5 acres to more than 50 acres in size. They are made up of about 55 percent Regent soils and 30 percent Rhoades soils. The Regent soil is on convex side slopes, and the Rhoades soil is on concave side slopes and in swales. These two soils are so intricately mixed or so small in size that it is not practical to separate them in mapping.

Typically, the Regent soil has a surface layer of grayish brown silty clay loam about 8 inches thick. The subsoil is about 25 inches thick. It is grayish brown silty clay in the upper part, light brownish gray silty clay in the middle part, and light olive gray silty clay loam in the lower part. Below this is soft bedrock. In some places the soil has a calcareous silty clay surface layer, in other places the soil has a surface layer of silt loam, and in a few places it does not have a layer of clay accumulation in the subsoil.

Typically, the Rhoades soil has a surface layer of grayish brown silty clay loam about 3 inches thick. The subsoil is dark grayish brown silty clay loam about 7 inches thick. The substratum is grayish brown silty clay to a depth of 29 inches. It is light olive brown clay to a depth of 59 inches. Below this is soft bedrock. In some places the soil has a thicker surface layer.

Included in mapping are small areas of Belfield, Cabba, Farland, Grail, and Savage soils. Belfield, Farland, Grail, and Savage soils have bedrock at a depth of 60 inches or more. Belfield and Grail soils are in swales, Farland soils are on terraces, and Savage soils are on foot slopes. Cabba soils are shallow to soft bedrock and are on hills and ridges. Also included are small scabby areas which are on the side slopes and which are barren of vegetation. These included soils make up about 15 percent of the unit.

Permeability is slow in the Regent soil and very slow in the Rhoades soil. Surface runoff is medium, and available water capacity is moderate in both soils. Root penetration is somewhat restricted by soft bedrock in the Regent soil at a depth of 33 inches and is restricted by the sodic subsoil in the Rhoades soil at a depth of about 3 inches. These soils are sticky when wet, which makes tillage difficult.

Most areas of this unit are used for cultivated crops, hay, range, and pasture. These soils are poorly suited to corn, flax, and small grain. They are better suited to grasses and legumes for pasture and hay. There is a slight hazard of soil blowing and a serious hazard of water erosion. Tillage that leaves large amounts of crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Loosening the dense, sodic subsoil by tillage or by growing deep rooted crops, such as alfalfa or sweetclover, allows root and water penetration. Avoiding tillage when these soils are wet helps reduce crusting and the formation of hard clods that make a poor seedbed. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility, maintain or improve soil tilth, and increase water infiltration.

A cover of range, pasture, or hay plants is effective in controlling erosion. Overstocking or overgrazing the range reduces the protective vegetative cover and causes deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

The Regent soil in this unit is suited to the trees and shrubs grown as windbreaks and environmental plantings. The Rhoades soil is generally not suited to these uses. Root penetration is restricted in areas of the Rhoades soil by the dense, sodic subsoil. Site selection, site preparation, and controlling competitive vegetation are important to the success of the planting.

These soils are poorly suited to sites for buildings and to septic tank absorption fields. The shrinking and swelling of these soils is a limitation to sites for buildings. This can be overcome by the use of reinforced footings and basement walls and by providing good surface drainage by grading the surface away from the building. The slow permeability and depth to bedrock limit the use of these soils for septic tank absorption fields. These limitations are difficult to overcome. Alternative systems of waste disposal to onsite disposal, such as holding tanks, should be considered. Effluent from septic tank absorption fields can follow bedding planes in the bedrock and can surface downslope or can contaminate ground water.

This unit is in capability subclass IVe.

62B—Rhoades silt loam, 1 to 6 percent slopes. This deep, nearly level and gently sloping soil is moderately well drained. It is on uplands. Individual areas are irregular in shape and range from 5 acres to more than 100 acres in size.

Typically, the surface layer is grayish brown silt loam about 3 inches thick. The subsoil is dark grayish brown silty clay loam about 7 inches thick. The substratum to a depth of 59 inches is grayish brown silty clay in the upper part and light olive brown clay in the lower part. Below this is soft bedrock. In some places the soil has a thicker surface layer.

Included in mapping are small areas of Belfield, Harriet, Morton, Regent, and Savage soils. Belfield soils have a thicker surface layer and are in swales. Harriet soils are poorly drained. They are on flood plains. Morton and Regent soils have soft bedrock at a depth of 20 to 40 inches. Regent and Morton soils are on side slopes. Savage soils are deep and have a surface layer of silty clay loam. They are on foot slopes. Also included are some areas of extremely stony Rhoades soils in swales and some areas which are small, scabby, and barren of vegetation and which are on the foot slopes and in swales. These included soils make up about 25 percent of the unit.

Permeability is very slow, surface runoff is slow, and available water capacity is moderate. Root penetration is restricted by the sodic subsoil at a depth of about 3 inches.

Most areas of this unit are used as rangeland and are better suited to this use. This soil is generally not suited to cultivated crops, hay, pasture, or the trees and shrubs grown as windbreaks and environmental plantings. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This soil is poorly suited to sites for buildings and is generally not suited to septic tank absorption fields. The shrinking and swelling of the soil is a limitation to sites for buildings. This can be overcome by the use of reinforced concrete footings and basement walls and by providing good surface drainage by grading the surface away from the building. Alternative systems of disposal to onsite disposal, such as holding tanks, should be considered.

This soil is in capability subclass VIs.

62D—Rhoades-Cabba loams, 9 to 15 percent slopes. These deep and shallow, strongly sloping soils are moderately well drained and well drained. They are on uplands. Individual areas are irregular in shape and range from 10 acres to more than 100 acres in size. They are made up of about 50 percent Rhoades soils and 25 percent Cabba soils. The Rhoades soil is on concave side slopes, and the Cabba soil is on hills and ridges. These soils are so intricately mixed or so small in size that it is not practical to separate them in mapping.

Typically, the Rhoades soil has a surface layer of grayish brown loam about 3 inches thick. The subsoil is dark grayish brown silty clay loam about 7 inches thick. The substratum to a depth of 59 inches is grayish brown silty clay in the upper part and light olive brown clay in the lower part. Below this is soft bedrock. In some places the soil has a thicker surface layer.

Typically, the Cabba soil has a surface layer of grayish brown loam about 3 inches thick. The next layer is light brownish gray silt loam about 5 inches thick. The substratum is grayish brown silt loam to a depth of 18 inches. Below this is soft bedrock. In some places the soil is shallow over porcelanite, and in other places it contains more clay.

Included with these soils in mapping are small areas of Badland and Amor, Arnegard, Harriet, and Morton soils. Amor and Morton soils are on side slopes and are moderately deep. Arnegard and Harriet soils are deep. Arnegard soils are in swales. The poorly drained Harriet soils are on flood plains. Also included are some very stony soils and areas of rock outcrop. These included soils make up about 25 percent of the unit.

Permeability is very slow in the Rhoades soil and moderate in the Cabba soil. Surface runoff is rapid. Available water capacity is moderate in the Rhoades soil and very low in the Cabba soil. Root penetration is restricted by the sodic subsoil in the Rhoades soil at a depth of about 3 inches and is restricted by soft bedrock in the Cabba soil at a depth of about 18 inches.

Most areas of this unit are used as rangeland and are better suited to this use. These soils are generally not suited to cultivated crops, hay, pasture, or the trees and shrubs grown as windbreaks and environmental plantings. A cover of range plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective plant cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This unit is poorly suited to sites for buildings and is generally not suited to septic tank absorption fields. The shrinking and swelling of these soils is a limitation to sites for buildings. This can be overcome by the use of reinforced footings and basement walls and by providing good drainage by grading the surface away from the building. The depth to bedrock is a limitation to construction that is easily overcome because the bedrock is soft and easily excavated. The depth to bedrock is difficult to overcome if the soil is used for septic tank absorption fields. Alternative systems of disposal, such as holding tanks, should be considered. Effluent from septic tank absorption fields can follow bedding planes in the bedrock and can surface downslope or can contaminate ground water.

This unit is in capability subclass VIs.

64—Badland. This steep to very steep, barren miscellaneous land area is dissected by numerous intermittent drainage channels and gullies. Slope ranges from 25 to 120 percent. Local relief ranges from 100 to 500 feet. Generally, this unit is on south-facing slopes. Individual areas are irregular in shape and range from 50 acres to more than 200 acres in size.

Typically, the Badland consists of exposed, highly erodible, silty and clayey, soft bedrock.

Included with this miscellaneous area in mapping are small areas of Arikara, Arnegard, Cabba, Cherry, and

Wayden soils. Arikara, Arnegard, and Cherry soils are more than 40 inches deep over bedrock. Arikara soils are in wooded draws and on wooded north-facing slopes. Arnegard soils are in swales and depressions. Cabba and Wayden soils are on hills and are shallow to bedrock. Cherry soils are on lower foot slopes and fans. These included soils make up about 15 percent of the unit.

Badland areas are undergoing active geological erosion, and surface runoff is very rapid. Soil slippage is common, and the steep slopes have a succession of short, vertical exposures.

Badland areas are used for grazing and wildlife habitat. This unit is not suited to cultivated crops, hay, pasture, rangeland, and the trees and shrubs grown as windbreaks and environmental plantings. It also is not suited to sanitary facilities or buildings. Badland areas are best suited to openland and rangeland wildlife habitat. Grazing is limited to the small areas of included soils which can support vegetation.

This unit is in capability subclass VIIIe.

67—Savage silty clay loam, 1 to 3 percent slopes. This deep, nearly level soil is well drained. It is on the lower part of side slopes and on foot slopes of uplands. Most areas are dissected by shallow drainageways. Individual areas are linear in shape and range from 5 acres to about 100 acres in size.

Typically, the surface layer is grayish brown silty clay loam about 5 inches thick. The subsoil is silty clay about 23 inches thick. It is grayish brown in the upper part and light brownish gray in the lower part. The substratum is light brownish gray silty clay to a depth of 60 inches. In some places the surface layer is thicker, in other places it is silt loam, and in a few places it is silty clay.

Included with this soil in mapping are small areas of Daglum, Morton, Regent, and Rhoades soils. Daglum and Rhoades soils are in swales, and they have a dense, sodic subsoil. Morton and Regent soils are moderately deep and are on side slopes. These included soils make up about 15 percent of the unit.

Permeability and surface runoff are slow, and available water capacity is high. This soil is sticky when it is wet. This makes tillage somewhat difficult.

Most areas of this soil are used for cultivated crops. This soil is suited to corn, flax, small grain, and grasses and legumes for pasture and hay. There is a slight hazard of soil blowing and water erosion. Tillage that leaves crop residue on the surface, buffer strips, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility and increase water infiltration. Avoiding tillage when the soil is wet helps prevent the formation of hard clods that make a poor seedbed.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Savage soil is well suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation, site selection, and controlling competitive vegetation are important to the success of the planting.

This soil is poorly suited to buildings and is generally not suited to septic tank absorption fields. The shrinking and swelling of the soil is a limitation to sites for buildings. This can be overcome by using reinforced footings and basement walls and by providing good surface drainage by grading the surface away from the building. The slow permeability limits the use of this soil for septic tank absorption fields. This limitation is difficult to overcome. Alternative systems to onsite disposal should be considered.

This soil is in capability subclass IIc.

67B—Savage silty clay loam, 3 to 6 percent slopes. This deep, gently sloping soil is well drained. It is on the lower part of side slopes and on foot slopes of uplands. Most areas are dissected by shallow drainageways. Individual areas are linear in shape and range from 5 acres to about 100 acres in size.

Typically, the surface layer is grayish brown silty clay loam about 5 inches thick. The subsoil is silty clay about 23 inches thick. It is grayish brown in the upper part and light brownish gray in the lower part. The substratum is light brownish gray silty clay to a depth of 60 inches. In some places the surface layer is thicker and darker colored, in other places the surface layer is silt loam, and in a few places the surface layer is silty clay.

Included with this soil in mapping are small areas of Daglum, Morton, Regent, and Rhoades soils. Daglum and Rhoades soils are in swales and have a dense, sodic subsoil. Morton and Regent soils are on side slopes and are moderately deep. These included soils make up about 15 percent of the unit.

Permeability is slow, surface runoff is medium, and available water capacity is high. This soil is sticky when it is wet. This makes tillage somewhat difficult.

Most areas of this soil are used for cultivated crops. This soil is well suited to corn, flax, small grain, and grasses and legumes for pasture and hay. There is a slight hazard of soil blowing and a moderate hazard of water erosion. Tillage that leaves moderate amounts of crop residue on the surface, buffer strips, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility and increase water infiltration. Avoiding tillage when this

soil is wet helps prevent the formation of hard clods that make a poor seedbed.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Savage soil is well suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation, site selection, and controlling competitive vegetation are important to the success of the planting.

This soil is poorly suited to sites for buildings and is generally not suited to septic tank absorption fields. The shrinking and swelling of this soil is a limitation to sites for buildings. This can be overcome by using reinforced footings and basement walls and by providing good surface drainage by grading the surface away from the building. The slow permeability limits the use of this soil for septic tank absorption fields. It is difficult to overcome. Alternative systems of disposal to onsite disposal should be considered.

This soil is in capability subclass IIe.

68—Vanda silty clay, 1 to 3 percent slopes. This deep, nearly level soil is well drained. It is on foot slopes, fans, and terraces. This unit is commonly dissected by gullies and drainageways. Individual areas are irregular in shape and range from 10 acres to about 100 acres in size.

Typically, the surface layer is light olive gray silty clay about 2 inches thick. The substratum is olive gray, light olive gray, and olive silty clay to a depth of 60 inches. In some places the soil has a darker surface layer and a sodic subsoil.

Included with this soil in mapping are small areas of Cherry and Havrelon soils. Cherry soils are on foot slopes and have a surface layer of silty clay loam. Havrelon soils are on fans and have a surface layer of silt loam. These included soils make up about 10 percent of the unit.

Permeability is very slow, surface runoff is slow, and available water capacity is low. Root penetration is restricted by the dense, sodic substratum at a depth of about 2 inches.

Most areas of this soil are used as rangeland and are better suited to this use. This soil is generally not suited to cultivated crops, hay, pasture, and the trees and shrubs grown as windbreaks and environmental plantings. A cover of range plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This soil is not suited to buildings or to septic tank absorption fields. Better sites are generally nearby.

This soil is in capability subclass VIs.

69B—Savage-Rhoades silty clay loams, 1 to 6 percent slopes. These deep, nearly level and gently sloping soils are well drained and moderately well drained. These soils are on terraces and alluvial fans. Many areas are dissected by shallow drainageways. Individual areas are linear in shape and range from 5 acres to more than 100 acres in size. They are made up of about 55 percent Savage soils and 25 percent Rhoades soils. The Savage soil is on convex side slopes and foot slopes, and the Rhoades soil is on concave side slopes and in swales. These soils are so intricately mixed or so small in size that it is not practical to separate them in mapping.

Typically, the Savage soil has a surface layer of grayish brown silty clay loam about 5 inches thick. The subsoil is silty clay about 23 inches thick. It is grayish brown in the upper part and light brownish gray in the lower part. The substratum is light brownish gray silty clay to a depth of 60 inches. In some places the surface layer is thicker and darker colored, and in other places it is silt loam or silty clay.

Typically, the Rhoades soil has a surface layer of grayish brown silty clay loam about 3 inches thick. The subsoil is dark grayish brown silty clay loam about 7 inches thick. The substratum to a depth of 59 inches is grayish brown silty clay in the upper part and light olive brown clay in the lower part. Below this is soft bedrock. In some places the soil has a thicker surface layer.

Included in mapping are small areas of Morton, Regent, and Straw soils. Morton and Regent soils are moderately deep and on side slopes. Straw soils have a thick, dark surface layer and are on flood plains. Also included are small scabby areas that are barren of vegetation. These included soils make up about 20 percent of the unit.

Permeability is slow in the Savage soil and very slow in the Rhoades soil. Surface runoff is medium in both soils. Available water capacity is high in the Savage soil and moderate in the Rhoades soil. In the Rhoades soil, root penetration is restricted by the dense sodic subsoil at a depth of about 3 inches. These soils are sticky when wet, which makes tillage somewhat difficult.

Most areas of this unit are used for cultivated crops. These soils are generally suited to corn, flax, small grain, and grasses and legumes for pasture and hay. There is a slight hazard of soil blowing and a moderate hazard of water erosion. Tillage that loosens the dense, sodic subsoil or growing deep rooted crops, such as alfalfa or sweetclover, allows root and moisture penetration. Avoiding tillage when these soils are wet prevents crusting and the formation of hard clods that make a poor seedbed. A cropping system that includes grasses and legumes improves or maintains soil tilth. Tillage that leaves moderate amounts of crop residue on the surface, stripcropping, grassed waterways, and

diversions help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility, improve or maintain tilth, and increase water infiltration.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

The Savage soil in this unit is well suited to the trees and shrubs grown as windbreaks and environmental plantings. The Rhoades soil is generally not suited to these uses. Root penetration is restricted in the Rhoades soil by the dense, sodic subsoil. Site selection, site preparation, and controlling competitive vegetation are important to the success of the planting.

These soils are poorly suited to sites for buildings and to septic tank absorption fields. The shrinking and swelling of these soils is a limitation to sites for buildings. This can be overcome by using reinforced footings and basement walls and by providing good surface drainage by grading the surface away from the building. The slow permeability limits the use of these soils for septic tank absorption fields. This limitation is difficult to overcome. Alternative systems of disposal to onsite disposal, such as holding tanks, should be considered.

This unit is in capability subclass IIIs.

70C—Searing loam, 3 to 9 percent slopes. This deep, gently sloping and moderately sloping soil is well drained. It is on uplands. It is moderately deep over shattered porcelanite. Individual areas are irregular in shape and range from 10 acres to more than 50 acres in size.

Typically, the surface layer is dark brown loam about 8 inches thick. The subsoil is reddish brown loam about 15 inches thick. The substratum is reddish yellow to a depth of 60 inches. It is channery loam in the upper part and shattered porcelanite in the lower part. In some places the soil has shattered porcelanite at a depth of 16 to 20 inches. In other places large porcelanite fragments, or "clinkers," are on the surface.

Included with this soil in mapping are small areas of Amor, Daglum, Morton, and Rhoades soils. Morton and Amor soils are on side slopes, and they are moderately deep to soft bedrock. Daglum and Rhoades soils are in swales and have a dense, sodic subsoil. These included soils make up about 20 percent of the unit.

Permeability is moderate in the upper part and very rapid in the lower part, surface runoff is medium, and available water capacity is moderate. Rooting depth is restricted by the porcelanite at a depth of about 33 inches. The surface layer is friable and easily tilled throughout a wide range in moisture content.

Most areas of this soil are used as rangeland or for hay and pasture. This soil is better suited to grasses and legumes for pasture and hay. It is poorly suited to corn, flax, and small grain. There is a slight hazard of soil blowing and a severe hazard of water erosion. Tillage that leaves large amounts of crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility, increase water infiltration, and increase water holding capacity.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Searing soil is suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation and controlling competitive vegetation are important to the success of the planting.

This soil is suited to sites for buildings. It is poorly suited to septic tank absorption fields because of very rapid permeability. Effluent from septic tank absorption fields may not be adequately filtered by the soil and, as a result, can contaminate ground water.

This soil is in capability subclass IVe.

71B—Sen silt loam, 3 to 6 percent slopes. This moderately deep, gently sloping soil is well drained. It is on side slopes and foot slopes of uplands. Individual areas are irregular in shape and range from 10 acres to more than 50 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The subsoil is brown silt loam about 11 inches thick. The substratum is white silt loam to a depth of 34 inches. Below this is soft bedrock. In some places the soil has a surface layer of loam, in other places it has carbonates in the upper 10 inches, and in a few places it has a subsoil of silty clay loam.

Included with this soil in mapping are small areas of Arnegard, Cabba, Farland, and Rhoades soils. Arnegard and Farland soils are deep. Arnegard soils are in swales, and Farland soils are on terraces. Rhoades soils have a dense, sodic subsoil. They are in swales. Cabba soils are shallow and on hills and ridges. These included soils make up about 15 percent of the unit.

Permeability and available water capacity are moderate, and surface runoff is medium. Root penetration is somewhat restricted by soft bedrock at a depth of about 34 inches. The surface layer is friable and easily tilled throughout a wide range in moisture content.

Most areas of this soil are used for cultivated crops. This soil is well suited to corn, flax, small grain, and grasses and legumes for pasture and hay. There is a

slight hazard of soil blowing and a moderate hazard of water erosion. Tillage that leaves moderate amounts of crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility and increase water infiltration.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Sen soil is well suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation and controlling competitive vegetation are important to the success of the planting.

This soil is suited to sites for buildings and is poorly suited to septic tank absorption fields. The shrinking and swelling of this soil is a limitation to sites for buildings. This can be overcome by using reinforced footings and basement walls and by providing good surface drainage by grading the surface away from the building. The depth to bedrock is a limitation to construction but is easily overcome because the bedrock is soft and easily excavated. Alternative systems to onsite disposal of waste, such as holding tanks, should be considered. Effluent from septic tank absorption fields can follow bedding planes in the bedrock and can surface downslope or can contaminate ground water.

This soil is in capability subclass IIe.

71C—Sen silt loam, 6 to 9 percent slopes. This moderately deep, moderately sloping soil is well drained. It is on side slopes and foot slopes of uplands. Individual areas are irregular in shape and range from 10 acres to more than 50 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 7 inches thick. The subsoil is brown silt loam about 11 inches thick. The substratum is white silt loam to a depth of 34 inches. Below this is soft bedrock. In some places the soil has a surface layer of loam, in other places it has carbonates in the upper 10 inches, and in a few places it has a subsoil of silty clay loam.

Included with this soil in mapping are small areas of Arnegard, Cabba, Farland, and Rhoades soils. Arnegard and Farland soils are deep. Arnegard soils are in swales, and Farland soils are on terraces. Cabba soils are shallow and on hills and ridges. Rhoades soils have a dense, sodic subsoil and are in swales. These included soils make up about 15 percent of the unit.

Permeability and available water capacity are moderate, and surface runoff is medium. Root penetration is restricted by soft bedrock at a depth of about 34 inches. The surface layer is friable and easily tilled throughout a wide range in moisture content.

Many areas of this soil are used for cultivated crops, but some are used for pasture or as rangeland. This soil is suited to corn, flax, small grain, and grasses and legumes for pasture and hay. There is a slight hazard of soil blowing and a severe hazard of water erosion. Tillage that leaves large amounts of crop residue on the surface, field windbreaks, stripcropping, grassed waterways, diversions, planting close growing crops, and minimizing summer fallow help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility, maintain soil tilth, and increase water infiltration.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Sen soil is well suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation and controlling competitive vegetation are important to the success of the planting. If windbreaks are planted, they should be planted on the contour to reduce the hazard of erosion from melting snow.

This soil is suited to sites for buildings and is poorly suited to septic tank absorption fields. The shrinking and swelling of this soil is a limitation to sites for buildings. This can be overcome by using reinforced footings and basement walls and by providing good surface drainage by grading the surface away from the building. The depth to bedrock is a limitation to sites for buildings but is easily overcome because the bedrock is soft and easily excavated. Alternative systems to onsite disposal of waste, such as holding tanks, should be considered. Effluent from septic tank absorption fields can follow bedding planes in the bedrock and can surface downslope or can contaminate ground water.

This soil is in capability subclass IIIe.

73C—Cherry-Vanda complex, 3 to 9 percent slopes, gullied. These deep, gently sloping and moderately sloping soils are well drained. They are on fans and foot slopes of uplands and on terraces. This unit is commonly dissected by gullies and drainageways. Individual areas are linear or irregular in shape and range from 5 acres to about 100 acres in size. They are made up of 50 percent Cherry soils and 40 percent Vanda soils. These soils are so small in size or so intricately mixed that it is not practical to separate them in mapping.

Typically, the Cherry soil has a surface layer of grayish brown silty clay loam about 4 inches thick. The subsoil is light brownish gray silty clay loam about 22 inches thick. The substratum is light brownish gray to a depth of 60 inches. It is silty clay loam in the upper part and stratified silty clay, silty clay loam, and silt loam in the lower part.

In some places the soil does not have a subsoil; in other places it is moderately deep and has a thicker, darker colored surface layer.

Typically, the Vanda soil has a surface layer of light olive gray silty clay about 2 inches thick. The substratum is olive gray, light olive gray, and olive silty clay to a depth of 60 inches. In some places the soil has a darker colored surface layer and a sodic subsoil.

Included with this unit in mapping are small areas of Badland and Cabba soils. Badland is barren, very steep, and eroding soft bedrock. Cabba soils are shallow and on hills and ridges. These included soils make up about 10 percent of the unit.

Permeability is moderately slow in the Cherry soil and very slow in the Vanda soil. Surface runoff is medium for both soils. Available water capacity is high in the Cherry soil and low in the Vanda soil. Root penetration is somewhat restricted by the dense, sodic substratum in the Vanda soil.

Most areas of this unit are used as rangeland and are best suited to this use. A cover of range plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

These soils are generally not suited to the trees and shrubs grown as windbreaks and environmental plantings. Individual plantings of adapted trees do well in the Cherry soil, but the Vanda soil and the gullied nature of the unit make row planting of trees and shrubs impractical. Careful site selection and preparation and controlling competitive vegetation are important to the success of tree plantings.

The Cherry soil is suited to sites for buildings, but the Vanda soil is generally not suited to this use. The Cherry soil is poorly suited to septic tank absorption fields and the Vanda soil is generally not suited to them. The shrinking and swelling of the Cherry soil is a limitation to sites for buildings. This can be overcome by using reinforced footings and basement walls and by providing good surface drainage by grading the surface away from the building. The permeability in the Cherry soil is a limitation for septic tank absorption fields. It can be overcome by enlarging the absorption field. The Vanda soil is generally avoided as sites for septic tank absorption fields.

This unit is in capability subclass VIe.

75—Straw loam. This deep, level soil is well drained. It is on flood plains and terraces. Slope is 0 to 1 percent. This soil is occasionally flooded. In a few places, especially on terraces, it is only rarely flooded. Individual areas are linear in shape and range from 10 acres to more than 100 acres in size.

Typically, the surface layer is 23 inches thick. It is dark grayish brown loam in the upper part, dark grayish brown silt loam in the middle part, and grayish brown silt loam in the lower part. The substratum is loam to a depth of 60 inches. It is grayish brown in the upper part and light brownish gray in the lower part. In some places the soil has a surface layer of thinner and lighter colored silt loam. In other places the soil is fine sandy loam.

Included with this soil in mapping are small areas of poorly drained Harriet soils and moderately well drained Rhoades soils. Harriet and Rhoades soils have a dense, sodic subsoil. They are on flood plains. Also included are small areas of stream cutbanks and channels. These included soils make up about 10 percent of the unit.

Permeability is moderate, surface runoff is slow, and available water capacity is high. The surface layer is friable and easily tilled throughout a wide range in moisture content.

Most areas of this soil are used for cultivated crops. This soil is well suited to growing corn, flax, small grain, and grasses and legumes for pasture and hay. There is a slight hazard of soil blowing and water erosion. Tillage that leaves crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help control soil erosion. Returning crop residue to the surface or the addition of organic material into the plow layer helps improve fertility and increase water infiltration. The flooding hazard for cultivated crops is slight because the soil is generally flooded following snowmelt and before crops are seeded.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and deferred grazing help keep the range and soil in good condition.

This Straw soil is well suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation and controlling competitive vegetation are important to the success of the planting. All climatically adapted species of trees and shrubs can grow well.

This soil supports native woodland along the stream channel. Common species are green ash, bur oak, American elm, various species of willow, juneberry, common chokecherry, silver buffaloberry, and prairie rose. This habitat provides a diversity of food and cover for grouse, pheasant, deer, red fox, rabbits, and other species of wildlife.

This soil is not suited to sites for buildings and to septic tank absorption fields because of the flooding hazard. Better sites are on nearby uplands that are not subject to flooding.

This soil is in capability subclass IIc.

79—Velva fine sandy loam, 1 to 3 percent slopes. This deep, nearly level soil is well drained. It is on flood plains and terraces. Many areas are dissected by

shallow drainageways that carry runoff from adjacent uplands and by stream channels. This soil is occasionally flooded. In a few places it is only rarely flooded. Individual areas are irregular in shape and range from 5 acres to about 100 acres in size.

Typically, the surface layer is dark grayish brown fine sandy loam about 11 inches thick. To a depth of 60 inches, the substratum is thin layers of grayish brown, dark grayish brown, and light brownish gray loamy fine sand, fine sandy loam, loamy sand, and stratified loam, fine sandy loam, and loamy fine sand. In some places the soil has a surface layer of silt loam or loam.

Included with this soil in mapping are small areas of Harriet, Rhoades, and Ruso soils. Harriet soils are poorly drained. Ruso soils have a substratum of very gravelly sand and are on terraces. Rhoades soils have a dense, sodic subsoil. They are in swales. Also included are small areas of stream cutbanks and channels. These included soils make up about 15 percent of the unit.

Permeability is moderately rapid, surface runoff is slow, and available water capacity is high. The surface layer is friable and easily tilled throughout a wide range in moisture content.

Most areas of this soil are used for cultivated crops or as rangeland. This soil is suited to corn, flax, small grain, and grasses and legumes for pasture and hay. There is a severe hazard of soil blowing and a slight hazard of water erosion. Tillage that leaves large amounts of crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Minimizing summer fallow and using cover crops also help prevent soil blowing. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility, maintain soil tilth, and improve infiltration of water. The flooding hazard for cultivated crops is small because the soil generally is flooded following snowmelt and before crops are planted.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Velva soil is well suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation and controlling competitive vegetation are important to the success of the planting.

Some areas have natural stands of native woodland. Common species are green ash, bur oak, American elm, various species of willow, juneberry, common chokecherry, silver buffaloberry, and prairie rose. This habitat provides a diversity of food and cover for grouse, pheasant, deer, fox, and other wildlife species.

This soil is generally not suited to sites for buildings and to septic tank absorption fields because of flooding. Better sites are generally on nearby uplands that are not subject to flooding.

This soil is in capability subclass IIIe.

81B—Vebar-Parshall fine sandy loams, 1 to 6 percent slopes. These moderately deep and deep, nearly level and gently sloping soils are well drained. They are on uplands. Individual areas are irregular in shape and range from 10 acres to more than 100 acres in size. They are made up of about 45 percent Vebar soils and 40 percent Parshall soils. The Vebar soil is on side slopes and the upper part of foot slopes, and the Parshall soil is on the lower part of foot slopes and in swales. These soils are so intricately mixed or so small in size that it is not practical to separate them in mapping.

Typically, the Vebar soil has a surface layer of dark grayish brown fine sandy loam about 8 inches thick. The subsoil is fine sandy loam about 15 inches thick. It is brown in the upper part and pale brown in the lower part. The substratum is light gray fine sandy loam to a depth of about 38 inches. Below this is soft sandstone bedrock. In some places the surface layer is eroded, thinner, and lighter colored.

Typically, the Parshall soil has a surface layer of dark grayish brown fine sandy loam about 15 inches thick. The subsoil is dark grayish brown fine sandy loam about 12 inches thick. The substratum is fine sandy loam to a depth of 60 inches. It is brown in the upper part, yellowish brown in the middle part, and light olive brown in the lower part. In some places the soil has more clay, and in other places the surface layer is thinner and lighter colored.

Included with these soils in mapping are small areas of Amor, Lihen, and Shambo soils. Amor and Shambo soils have more clay throughout. Amor soils are on side slopes, and Shambo soils are on terraces. Lihen soils have a surface layer of loamy fine sand. They are on slight ridges. These included soils make up about 15 percent of the unit.

Permeability is moderately rapid in both the Vebar and Parshall soils. Available water capacity is low in the Vebar soil and moderate in the Parshall soil. Surface runoff is slow for both soils. The surface layer is friable and easily tilled throughout a wide range in moisture content.

Most areas of this unit are used for cultivated crops or as rangeland. These soils are suited to flax, small grain, and grasses and legumes for pasture and hay. There is a severe hazard of soil blowing and a slight hazard of water erosion. Tillage that leaves large amounts of crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Minimizing summer fallow and using cover crops also help prevent soil blowing. Returning crop residue to the surface or the addition of other

organic material into the plow layer helps improve fertility, maintain soil tilth, and increase water infiltration.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

These Vebar and Parshall soils are suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation, the soil's lying fallow the year preceding planting, and controlling competitive vegetation are important to the success of the planting.

These soils are suited to sites for buildings. The Parshall soil is suited to septic tank absorption fields, but the Vebar soil is poorly suited to this use. The depth to bedrock in the Vebar soil is a limitation to sites for buildings. This limitation can be overcome because the rock is soft and easily excavated. It is difficult to overcome, however, when the soil is used for septic tank absorption fields. Effluent from filter fields can follow bedding planes in the bedrock and can surface down slope or can contaminate ground water. Septic tank absorption fields are best located in the Parshall soil.

This unit is in capability subclass IIIe.

81C—Vebar-Parshall fine sandy loams, 6 to 9 percent slopes. These moderately deep and deep, moderately sloping soils are well drained. They are on uplands. Individual areas are irregular in shape and range from 10 acres to more than 100 acres in size. They are made up of about 60 percent Vebar soils and 20 percent Parshall soils. The Vebar soil is on side slopes and the upper part of foot slopes, and the Parshall soil is on the lower part of foot slopes and in swales. These soils are so intricately mixed or so small in size that it is not practical to separate them in mapping.

Typically, the Vebar soil has a surface layer of dark grayish brown fine sandy loam about 8 inches thick. The subsoil is fine sandy loam about 15 inches thick. It is brown in the upper part and pale brown in the lower part. The substratum is light gray fine sandy loam to a depth of about 38 inches. Below this is soft sandstone bedrock. In some places the surface layer is eroded, thinner, and lighter colored.

Typically, the Parshall soil has a surface layer of dark grayish brown fine sandy loam about 15 inches thick. The subsoil is dark grayish brown fine sandy loam about 12 inches thick. The substratum is fine sandy loam to a depth of 60 inches. It is brown in the upper part, yellowish brown in the middle part, and light olive brown in the lower part. In some places the soil has more clay, and in other places the surface layer is thinner and lighter colored.

Included with these soils in mapping are small areas of Amor, Cohagen, Lihen, and Shambo soils. Amor soils have more clay and are on side slopes. Cohagen soils are shallow and on ridges. Lihen soils are deep, have a surface layer of loamy fine sand, and are on slight ridges. Shambo soils are deep, have a surface layer of loam, and are on terraces. These included soils make up about 20 percent of the unit.

Permeability is moderately rapid in both the Vebar and Parshall soils. Available water capacity is low in the Vebar soil and moderate in the Parshall soil. Surface runoff is medium for both soils. The surface layer is friable and easily tilled throughout a wide range in moisture content.

Most areas of this unit are used for cultivated crops or as rangeland. These soils are poorly suited to corn, flax, and small grain. They are better suited to grasses and legumes for pasture and hay. There is a severe hazard of soil blowing and water erosion. Tillage that leaves large amounts of crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Maintaining a protective vegetative cover, minimizing summer fallow, and avoiding low residue crops also help prevent soil blowing.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

These Vebar and Parshall soils are suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation, the soil's lying fallow the year preceding planting, and controlling competitive vegetation are important to the success of the planting.

These soils are suited to sites for buildings. The Parshall soil is suited to septic tank absorption fields, but the Vebar soil is poorly suited to this use. The depth to rock in the Vebar soil is a limitation to sites for buildings. This limitation can be overcome during construction because the rock is soft and easily excavated. It is difficult to overcome, however, if this soil is used for septic tank absorption fields. Effluent from septic tank absorption fields can follow bedding planes in the bedrock and can surface downslope or can contaminate ground water. Septic tank absorption fields are best located on the Parshall soil.

This unit is in capability subclass IVe.

81D—Vebar fine sandy loam, 9 to 15 percent slopes. This moderately deep, well drained soil is strongly sloping. It is on side slopes of uplands. This unit is often dissected by shallow drainageways. Individual areas of this unit are irregular in shape and range from 5 acres to more than 100 acres in size.

Typically, the surface layer is dark grayish brown fine sandy loam about 8 inches thick. The subsoil is fine sandy loam about 15 inches thick. It is brown in the

upper part and pale brown in the lower part. The substratum is light gray fine sandy loam to a depth of 38 inches. Below this is soft sandstone bedrock. In some places the surface layer is eroded, thinner, and lighter colored. In other places the soil is deep and has a surface layer of loamy fine sand.

Included with this soil in mapping are areas of Amor, Arnegard, Cabba, and Cohagen soils. Amor soils have a surface layer and subsoil of loam and are on side slopes. Arnegard soils are deep and have a thicker surface layer of darker colored loam. They are in swales. Cohagen and Cabba soils are shallow and on ridges and hills. Also included are small areas of rock outcrop or stony areas. These included soils make up about 20 percent of the unit.

Permeability is moderately rapid. Available water capacity is low, and surface runoff is medium. Root penetration is restricted by soft bedrock at a depth of about 38 inches.

Most areas of this soil are used as rangeland and this soil is best suited to this use. This soil is generally not suited to cultivated crops. There is a severe hazard of soil blowing and water erosion. A cover of range plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Vebar soil is poorly suited to the trees and shrubs grown as windbreaks and environmental plantings. Properly selected tree and shrub species can be established, but optimum survival, growth, and vigor should not be required or expected. Careful site selection, preparation, and controlling competitive vegetation are important to the success of the planting.

This soil is suited to sites for buildings but is poorly suited to septic tank absorption fields. The depth to rock is a limitation to sites for buildings. This limitation can be overcome because the rock is soft and easily excavated. Buildings should be designed to conform to the natural slope of the land. Land shaping may be needed in some areas. The depth to rock is difficult to overcome for septic tank absorption fields. Effluent from septic tank absorption fields can follow bedding planes in the bedrock and can surface downslope or can contaminate ground water. Alternative systems to onsite disposal, such as holding tanks, should be considered.

This soil is in capability subclass VIe.

82D—Vebar extremely stony fine sandy loam, 3 to 15 percent slopes. This gently sloping to strongly sloping, moderately deep soil is well drained. It is on side slopes of uplands. Most areas are dissected by drainageways. Individual areas of this unit are irregular in shape and range from 5 acres to more than 100 acres in size. Large stones, of glacial or residual origin, cover from 3 to 15 percent of the surface.

Typically, the surface layer is dark grayish brown fine sandy loam about 8 inches thick. The subsoil is fine sandy loam about 15 inches thick. It is brown in the upper part and pale brown in the lower part. The substratum is light gray fine sandy loam to a depth of 38 inches. Below this is soft sandstone bedrock. In some places the surface layer is sandy loam. In other areas the soil is more than 40 inches deep to soft bedrock.

Included with this soil in mapping are small areas of Arnegard, Cohagen, Flaxton, Rhoades, and Williams soils. Arnegard soils are deep, have a thicker, darker colored surface layer, and are in swales. Cohagen soils are shallow and on hills. Flaxton soils have a substratum of clay loam or loam. They are on side slopes. Rhoades soils have a dense, sodic subsoil. They are in swales. Williams soils have a subsoil of clay loam. They are on side slopes. These included soils make up 20 percent of the unit.

Permeability is moderately rapid. Available water capacity is low, and surface runoff is rapid. The stones on the surface make tillage generally impractical.

Most areas of this soil are used as rangeland. This soil is generally not suited to cultivated crops. There is a severe hazard of soil blowing and water erosion. A cover of range plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Vebar soil is generally not suited to the trees and shrubs grown as windbreaks and environmental plantings. Individual plantings of climatically adapted trees and shrubs can grow well, but the stony, droughty nature of this soil reduces the suitability for row plantings of trees.

This soil is suited to sites for buildings and is poorly suited to septic tank absorption fields. The depth to rock is a limitation to sites for buildings and to septic tank absorption fields. This limitation can be overcome during construction because the rock is soft and easily excavated. Buildings should be designed to conform to the natural slope of the land. Land shaping may be needed in some areas. Effluent from septic tank absorption fields, however, can follow bedding planes in the rock and can surface downslope or can contaminate ground water. Alternative systems to onsite disposal, such as holding tanks, should be considered.

This soil is in capability subclass VIIs.

83E—Baahish fine sandy loam, 9 to 50 percent slopes. This deep, strongly sloping to very steep soil is somewhat excessively drained. It is on the upper and lower parts of side slopes of dissected uplands. This soil is shallow over very gravelly material. Individual areas

are linear in shape and range from 10 acres to about 100 acres in size.

Typically, the surface layer is very dark grayish brown fine sandy loam about 3 inches thick. The subsoil is about 10 inches thick. It is dark grayish brown sandy loam in the upper part and brown fine sandy loam in the lower part. The substratum is light gray very gravelly fine sandy loam and very gravelly loam to a depth of 60 inches. In some places the soil has a surface layer of gravelly loam, and in other places the soil is moderately deep or deep over sand and gravel.

Included with this soil in mapping are small areas of Arnegard and Rhoades soils. They are in swales. Arnegard soils are deep and have a surface layer and subsoil of loam. Rhoades soils have a dense, sodic subsoil. These included soils make up about 20 percent of the unit.

Permeability is moderate in the surface layer and subsoil and rapid in the substratum. Surface runoff is medium. Available water capacity is low. Rooting depth is somewhat restricted by very gravelly fine sandy loam at a depth of about 13 inches.

Most areas of this soil are used as rangeland. It is better suited to rangeland and wildlife habitat. This soil is generally not suited to cultivated crops, hay, pasture, or the trees and shrubs grown as windbreaks and environmental plantings. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This soil is poorly suited to sites for buildings and is generally not suited to septic tank absorption fields. Buildings should be designed to conform to the natural slope of the land. Land shaping may be needed in some areas. Because of the rapid permeability, the soil may not adequately filter effluent from septic tank absorption fields. There is a possibility of effluent contaminating ground water.

This soil is in capability subclass VIIe.

84—Hidatsa loam, 1 to 3 percent slopes. This deep, nearly level soil is well drained. It is on fans and terraces. This soil is moderately deep over very gravelly material (fig. 11). Individual areas are irregular in shape and range from 10 acres to more than 300 acres in size.

Typically, the surface layer is dark grayish brown loam about 6 inches thick. The subsoil is brown loam about 16 inches thick. The substratum is light brownish gray very gravelly sandy loam to a depth of 60 inches. In some places the surface layer and subsoil have more sand, and in other places the gravelly substratum is at a depth of 30 to 45 inches.

Included with this soil in mapping are small areas of Arnegard, Baahish, and Farland soils. Arnegard soils do not have the gravelly substratum that the Hidatsa soil has. They are in swales. Baahish soils have a gravelly substratum at a depth of less than 15 inches. They are on side slopes. Farland soils have a surface layer of silt loam and a subsoil of silty clay loam. They are on terraces. These included soils make up about 10 percent of the unit.

Figure 11.—Profile of Hidatsa loam. Gravel is at a depth of about 26 inches.

Permeability is moderate through the surface layer and subsoil and rapid in the substratum. Surface runoff is slow. Available water capacity is low. Rooting depth is somewhat restricted by very gravelly sandy loam at about 22 inches. The surface layer is friable and easily tilled throughout a wide range in moisture content.

Most areas of this soil are used for cultivated crops. This soil is suited to small grain, corn, flax, and grasses and legumes for pasture and hay. There is a slight hazard of soil blowing and water erosion. Tillage that leaves crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help

prevent excessive soil loss. Returning crop residue to the soil or the addition of other organic material into the plow layer helps improve fertility, maintain soil tilth, and increase water infiltration.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Hidatsa soil is poorly suited to the trees and shrubs grown as windbreaks and environmental plantings. Properly selected, climatically adapted tree and shrub species can be established, but optimum survival, growth, and vigor should not be required or expected. Site preparation and controlling competitive vegetation are important to the success of the planting.

This soil is well suited to sites for buildings, but is poorly suited to septic tank absorption fields. Because of the rapid permeability, the soil may not adequately filter effluent from septic tank absorption fields. There is a possibility of ground water contamination.

This soil is in capability subclass IIIs.

84B—Hidatsa loam, 3 to 6 percent slopes. This deep, gently sloping soil is well drained. It is on fans and terraces. This soil is moderately deep over very gravelly material. Individual areas are irregular in shape and range from 10 acres to more than 100 acres in size.

Typically, the surface layer is dark grayish brown loam about 6 inches thick. The subsoil is brown loam about 16 inches thick. The substratum is light brownish gray very gravelly sandy loam to a depth of 60 inches. In some places the surface layer and subsoil contain more sand, and in other places the gravelly substratum is at a depth of 30 to 45 inches.

Included with these soils in mapping are small areas of Arnegard, Baahish, Farland, and Shambo soils. Arnegard, Farland, and Shambo soils do not have the gravelly substratum that this Hidatsa soil has. The Arnegard soils are in swales, and the Farland and Shambo soils are on terraces. Baahish soils have a gravelly substratum at a depth of less than 15 inches. They are on side slopes. These included soils make up about 10 percent of the unit.

Permeability is moderate in the surface layer and subsoil and rapid in the substratum. Surface runoff is slow. Available water capacity is low. Rooting depth is somewhat restricted by very gravelly sandy loam at a depth of 22 inches. The surface layer is friable and easily tilled throughout a wide range in moisture content.

Most areas of this soil are used for cultivated crops. This soil is suited to small grain, corn, flax, and grasses and legumes for pasture and hay. There is a slight hazard of soil blowing and a moderate hazard of water erosion. Tillage that leaves moderate amounts of crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility, maintain soil tilth, and increase water infiltration.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Hidatsa soil is poorly suited to the trees and shrubs grown as windbreaks and environmental plantings. Properly selected, climatically adapted tree and shrub species can be established, but optimum survival, growth, and vigor should not be required or expected. Site preparation and controlling competitive vegetation are important to the success of the planting.

This soil is well suited to sites for buildings and is poorly suited to septic tank absorption fields. Because of the rapid permeability, the soil may not adequately filter effluent from septic tank absorption fields. There is a possibility of ground water contamination.

This soil is in capability subclass IIIe.

86F—Brandenburg-Cabba loams, 6 to 50 percent slopes. These deep and shallow, moderately sloping to very steep soils are excessively drained and well drained. They are on hills and ridges of uplands. Many areas are dissected by drainageways. Fragments of porcelanite on the surface and porcelanite outcrops are on crests of the cone-shaped hills and ridges. Individual areas are irregular in shape and range from 5 acres to more than 400 acres in size. They are made up of 50 percent Brandenburg soils and 25 percent Cabba soils. These soils are so intricately mixed or so small in size that it is not practical to separate them in mapping.

Typically, the Brandenburg soil has a surface layer of brown loam about 6 inches thick. The substratum is light red very channery loam to a depth of 10 inches. Light red, shattered porcelanite is at a depth of 10 inches. In some places the soil is moderately deep to porcelanite.

Typically, the Cabba soil has a surface layer of grayish brown loam about 3 inches thick. The next layer is light brownish gray silt loam about 5 inches thick. The substratum is grayish brown silt loam to a depth of 18 inches. Below this is soft bedrock. In some places the soil has a surface layer of fine sandy loam or silt loam.

Included with these soils in mapping are small areas of Amor, Arnegard, Rhoades, and Vebar soils. All of these soils are deeper than 20 inches to soft bedrock or shattered porcelanite. Amor soils have a subsoil of loam, and Vebar soils have a subsoil of fine sandy loam. Both soils are on side slopes. Arnegard soils have a thick, dark colored surface layer of loam. Rhoades soils have a dense, sodic subsoil. The Arnegard and Rhoades soils

are in swales. These included soils make up about 25 percent of the unit.

Permeability is moderate in the Cabba soil and in the surface layer of the Brandenburg soil, but it is rapid in the substratum of the Brandenburg soil. Surface runoff is rapid in both soils. Available water capacity is very low in the Brandenburg soil and low in the Cabba soil. Root penetration is somewhat restricted by fractured porcelanite in the Brandenburg soil at a depth of about 16 inches, and it is restricted by soft bedrock in the Cabba soil at a depth of about 18 inches.

Most areas of this unit are used as rangeland and are better suited to this use. These soils are generally not suited to cultivated crops, hay, pasture, or the trees and shrubs grown as windbreaks and environmental plantings. A cover of range plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

These soils are poorly suited to sites for buildings and are generally not suited to septic tank absorption fields. Buildings should be designed to conform to the natural slope of the land. Land shaping may be needed in some areas. Effluent from septic tank filter fields may not be adequately filtered in the Brandenburg soil because of the very rapid permeability. Ground water contamination is possible. In the Cabba soil effluent can follow bedding planes in the bedrock and can surface downslope. Alternative systems to onsite disposal, such as holding tanks, should be considered.

This unit is in capability subclass VIIs.

87F—Lakoa loam, 15 to 45 percent slopes. This deep, moderately steep to very steep soil is well drained. It is on the lower part of side slopes of uplands. Individual areas are irregular in shape and range from 10 acres to more than 500 acres in size.

Typically, the Lakoa soil has a 1-inch layer of decomposed leaves and twigs on the surface layer. The surface layer is dark gray loam about 1 inch thick. The subsurface layer is light brownish gray loam about 7 inches thick. The subsoil layer is clay loam about 21 inches thick. It is light brownish gray in the upper part and grayish brown in the lower part. The substratum is loam to a depth of 60 inches. It is light gray in the upper part and light brownish gray in the lower part. In some places the soil has a thinner solum and contains less clay. In other places the soil has more sand.

Included with this soil in mapping are small areas of Amor, Baahish, Cabba, and Cherry soils and small areas of limestone rock outcrop and boulders. Amor soils are moderately deep. Baahish soils are shallow over very gravelly material. Both soils are on side slopes. Cabba soils are shallow. They are on hills and ridges. Cherry soils have a surface layer of silty clay loam. They are on fans and foot slopes. These included soils make up about 15 percent of the unit.

Permeability is moderate, surface runoff is rapid, and available water capacity is high.

Most areas of this soil are used for wooded pasture and are better suited to this use. This soil is generally not suited to cultivated crops, hay, pasture, or to the trees and shrubs grown as windbreaks and environmental plantings. Grazing is limited to sparse stands of grass under the trees. The wooded areas are valued as summer shade and winter protection for livestock. Overstocking and overgrazing these wooded pastures damage the organic layer on the soil surface and reduce the protective vegetative cover. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the pasture and soil in good condition.

This soil is well suited to woodland wildlife habitat. The woodland cover includes bur oak, quaking aspen, green ash, American elm, various species of willow, common chokecherry, juneberry, prairie rose, and gooseberry. The undercover includes sparse, scattered grasses.

This soil is poorly suited to sites for buildings and is generally not suited to septic tank absorption fields because of slope. Buildings should be designed to conform to the natural slope of the land. Land shaping may be needed in some areas. Alternative systems to onsite disposal of waste, such as holding tanks, should be considered.

This soil is in capability subclass VIIe.

88—Williams loam, 1 to 3 percent slopes. This deep, nearly level soil is well drained. It is on glacial till uplands. Individual areas are irregular in shape and range from 5 acres to more than 100 acres in size.

Typically, the surface layer is dark grayish brown loam about 8 inches thick. The subsoil is clay loam about 15 inches thick. It is brown in the upper part and light brownish gray in the lower part. The substratum is light gray clay loam to a depth of 60 inches. In places the soil has a surface layer of fine sandy loam or silt loam.

Included with this soil in mapping are small areas of well drained Arnegard, moderately well drained Noonan, and poorly drained Tonka soils. Arnegard soils have a thicker and darker colored surface layer. They are in swales. Noonan soils have a dense, sodic subsoil. They are in slight depressions. Tonka soils have a subsoil of silty clay and silty clay loam. They are in shallow depressions. These included soils make up about 10 percent of the unit.

Permeability is moderately slow, surface runoff is slow, and available water capacity is high. This soil has a few stones on the surface that interfere with tillage and harvest operations. The surface layer is friable and easily tilled throughout a wide range in moisture content.

Most areas of this soil are used for cultivated crops. This soil is well suited to corn, flax, small grain, or grasses and legumes for pasture and hay. There is a

slight hazard of soil blowing and a moderate hazard of water erosion. Tillage that leaves crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help control erosion. Returning crop residue to the surface or the addition of organic material into the plow layer helps improve fertility, maintain soil tilth, and increase water infiltration.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and deferred grazing help keep the range and soil in good condition.

This Williams soil is suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation and controlling competitive vegetation are important to the success of the planting. Most climatically adapted species of trees and shrubs can grow well.

This soil is suited to sites for buildings and is poorly suited to septic tank absorption fields. The moderate shrinking and swelling of this soil is a limitation to sites for buildings. This can be overcome by using reinforced concrete walls and footings and by providing good surface drainage by grading the surface away from the building. The moderately slow permeability limits the use of this soil for septic tank absorption fields. This limitation can be overcome by enlarging the absorption field.

This soil is in capability subclass IIc.

88B—Williams loam, 3 to 6 percent slopes. This deep, undulating soil is well drained. It is on glacial till uplands. Individual areas are irregular in shape and range from 5 acres to more than 100 acres in size.

Typically, the surface layer is dark grayish brown loam about 8 inches thick. The subsoil is clay loam about 15 inches thick. It is brown in the upper part and light brownish gray in the lower part. The substratum is light gray clay loam to a depth of 60 inches. In some places the soil has a surface layer of silt loam or fine sandy loam.

Included with this soil in mapping are small areas of Arnegard, Noonan, and Tonka soils. Arnegard soils have a thicker, darker colored surface layer. They are in swales. Noonan soils have a dense, sodic subsoil. They are in slight depressions. Tonka soils have a subsoil of silty clay and silty clay loam and are poorly drained. They are in shallow depressions. These included soils make up about 15 percent of the unit.

Permeability is moderately slow, surface runoff is medium, and available water capacity is high. This soil has a few stones on the surface that interfere with tillage and harvest operations. The surface layer is friable and easily tilled throughout a wide range in moisture content.

Most areas of this soil are used for cultivated crops. This soil is well suited to corn, flax, small grain, or grasses and legumes for pasture and hay. There is a slight hazard of soil blowing and a moderate hazard of water erosion. Tillage that leaves a moderate amount of crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility, maintain soil tilth, and increase water infiltration.

A cover of pasture, hay, or range plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Williams soil is suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation and controlling competitive vegetation are important to the success of the planting. Most climatically adapted species of trees and shrubs can grow well.

This soil is suited to sites for buildings and is poorly suited to septic tank absorption fields. The moderate shrinking and swelling of the soil is a limitation to sites for buildings. This can be overcome by using reinforced footings and basement walls and providing good surface drainage by grading the surface away from the building. The moderately slow permeability limits the use of this soil for septic tank absorption fields. This limitation can be overcome by enlarging the absorption field.

This soil is in capability subclass IIe.

88C—Williams loam, 6 to 9 percent slopes. This deep, gently rolling soil is well drained. It is on glacial till uplands. Individual areas are irregular in shape and range from 5 acres to more than 100 acres in size.

Typically, the surface layer is dark grayish brown loam about 8 inches thick. The subsoil is clay loam about 15 inches thick. It is brown in the upper part and light brownish gray in the lower part. The substratum is light gray clay loam to a depth of 60 inches. In some places the soil has a surface layer of fine sandy loam or silt loam.

Included with this soil in mapping are small areas of Arnegard, Noonan, and Zahl soils. Arnegard soils have a thicker, darker colored surface layer. They are in swales. Noonan soils have a dense, sodic subsoil. They are in slight depressions. Zahl soils have a thinner surface layer. They are on knobs. These included soils make up about 15 percent of the unit.

Permeability is moderately slow, surface runoff is medium, and available water capacity is high. This soil has a few stones on the surface that interfere with tillage and harvest operations. The surface layer is friable and easily tilled throughout a wide range in moisture content.

Most areas of this soil are used for cultivated crops. This soil is suited to corn, flax, small grain, and grasses

and legumes for pasture and hay. There is a slight hazard of soil blowing and a severe hazard of water erosion. Tillage that leaves a large amount of crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Returning crop residue to the soil or the addition of other organic material into the plow layer helps improve fertility, maintain soil tilth, and increase water infiltration.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Williams soil is suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation and controlling competitive vegetation are important to the success of the planting. Most climatically adapted species have the potential to grow well.

This soil is suited to sites for buildings and is poorly suited to septic tank absorption fields. The shrinking and swelling of this soil is a limitation to sites for buildings. This can be overcome by using reinforced footings and basement walls and by providing good surface drainage by grading the surface away from the building. The moderately slow permeability limits the use of this soil for septic tank absorption fields. This limitation can be overcome by enlarging the absorption field.

This soil is in capability subclass IIIe.

90C—Williams extremely stony loam, 1 to 9 percent slopes. This deep, nearly level to gently rolling soil is well drained. It is on glacial till uplands. Individual areas are irregular in shape and range from 5 acres to more than 100 acres in size. Large stones of glacial origin cover from 3 to 15 percent of the surface.

Typically, the surface layer is dark grayish brown extremely stony loam about 8 inches thick. The subsoil is clay loam about 15 inches thick. It is brown in the upper part and light brownish gray in the lower part. The substratum is light gray clay loam to a depth of 60 inches. In some places the soil has a surface layer of fine sandy loam or silt loam.

Included with this soil in mapping are small areas of Arnegard, Noonan, Tonka, and Zahl soils. Arnegard soils have a thicker, darker colored surface layer. They are in swales. Noonan soils have a dense, sodic subsoil. They are in slight depressions. Tonka soils are poorly drained and have a subsoil of silty clay and silty clay loam. They are in shallow depressions. Zahl soils have a thinner surface layer. They are on knobs. These included soils make up about 15 percent of the unit.

Permeability is moderately slow, surface runoff is medium, and available water capacity is high. Stones on the surface make all tillage impractical unless the stones are removed.

Most areas of this soil are used as rangeland and are better suited to this use. This soil is generally not suited to corn, flax, small grain, and grasses and legumes for pasture and hay. A cover of range plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Williams soil is generally not suited to the trees and shrubs grown as windbreaks and environmental plantings. Trees and shrubs grow well in the soil, but the stony nature of the unit limits its suitability for row planting and cultivating of trees.

This soil is suited to sites for buildings and is poorly suited to septic tank absorption fields. The shrinking and swelling of the soil is a limitation to sites for buildings. This can be overcome by using reinforced footings and basement walls and by providing good surface drainage by grading the surface away from the building. The moderately slow permeability limits the use of this soil for septic tank absorption fields. This limitation can be overcome by enlarging the absorption field.

This soil is in capability subclass VIIs.

91B—Williams-Noonan loams, 3 to 6 percent slopes. These deep, undulating soils are well drained and moderately well drained. They are on glacial till plains. Individual areas are irregular in shape and range from 5 acres to about 80 acres in size. They are made up of about 50 percent Williams and 30 percent Noonan soils. The Williams soil is on convex slopes, and the Noonan soil is on concave slopes. These soils are so intricately mixed or so small in size that it is not practical to separate them in mapping.

Typically, the Williams soil has a surface layer of dark grayish brown loam about 8 inches thick. The subsoil is clay loam about 15 inches thick. It is brown in the upper part and light brownish gray in the lower part. The substratum is light gray clay loam to a depth of 60 inches. In some places the surface layer is silt loam.

Typically, the Noonan soil has a surface layer of grayish brown loam about 7 inches thick. The subsurface layer is light brownish gray loam about 1 inch thick. The subsoil is dark brown clay loam about 13 inches thick. The substratum is clay loam to a depth of 60 inches. It is light olive brown in the upper part and light gray in the lower part.

Included with these soils in mapping are small areas of Arnegard, Flaxton, Lefor, Rhoades, and Tonka soils. Arnegard soils have a thicker, darker colored surface layer. They are in swales. Lefor soils are moderately deep and have a surface layer of fine sandy loam. They are on side slopes. Flaxton soils have a surface layer of fine sandy loam. They are on side slopes. Rhoades soils

have a dense, sodic subsoil. They are in swales. Tonka soils are poorly drained and have a subsoil of silty clay and silty clay loam. They are in shallow depressions. These included soils make up about 20 percent of the unit.

Permeability is moderately slow in the Williams soil and slow in the Noonan soil. Surface runoff is medium for both soils. Available water capacity is high in the Williams soil and moderate in the Noonan soil. These soils have a few stones on the surface that interfere with tillage and harvest operations. Root penetration is restricted by the dense, sodic subsoil in the Noonan soil at a depth of about 8 inches.

Most areas of this unit are used for cultivated crops. These soils are suited to small grain, corn, and grasses and legumes for pasture and hay. There is a slight hazard of soil blowing and moderate hazard of water erosion. Tillage that leaves moderate amounts of crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Tillage that loosens the dense, sodic claypan in the Noonan soil or growing deep rooted crops, such as alfalfa and sweetclover, allows root and water penetration. Avoiding tillage when the soil is wet prevents crusting and the formation of hard clods that make a poor seedbed. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility, maintain or improve soil tilth, and increase water infiltration.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

The Williams soil in this unit is suited to the trees and shrubs grown as windbreaks and environmental plantings. The Noonan soil is poorly suited to these uses. Root penetration is restricted by the sodic subsoil in the Noonan soil. Site selection, site preparation, and controlling competitive vegetation are important to the success of the planting.

These soils are suited to sites for buildings but are poorly suited to septic tank absorption fields. The shrinking and swelling of these soils are a limitation to sites for buildings. This can be overcome by using reinforced footings and basement walls and by providing good surface drainage by grading the surface away from the building. The permeability limits the use of these soils for septic tank absorption fields. This limitation can be overcome by enlarging the absorption field. The Williams soil in this unit is better suited to septic tank absorption fields than the Noonan soil.

This unit is in capability subclass IIIe.

91C—Williams-Noonan loams, 6 to 9 percent slopes. These deep, gently rolling soils are well drained and moderately well drained. They are on glacial till plains. Individual areas are irregular in shape and range from 5 acres to about 50 acres in size. They are made up of about 50 percent Williams soils and 30 percent Noonan soils. The Williams soil is on convex slopes, and the Noonan soil is on concave slopes. These soils are so intricately mixed or so small that it is not practical to separate them in mapping.

Typically, the Williams soil has a surface layer of dark grayish brown loam about 8 inches thick. The subsoil is clay loam about 15 inches thick. It is brown in the upper part and light brownish gray in the lower part. The substratum is light gray clay loam to a depth of 60 inches. In some places the soil has a surface layer of silt loam.

Typically, the Noonan soil has a surface layer of grayish brown loam about 7 inches thick. The subsurface layer is light brownish gray loam about 1 inch thick. The subsoil is dark brown clay loam about 13 inches thick. The substratum is clay loam to a depth of 60 inches. It is light olive brown in the upper part and light gray in the lower part.

Included with these soils in mapping are small areas of Arnegard, Flaxton, Lefor, Rhoades, and Tonka soils. Arnegard soils have a thicker, darker colored surface layer. They are in swales. Flaxton and Lefor soils have a surface layer of fine sandy loam. They are on side slopes. Rhoades soils have a dense, sodic subsoil. They are in swales. Tonka soils are poorly drained and have a subsoil of silty clay and silty clay loam. They are in shallow depressions. These included soils make up about 20 percent of the unit.

Permeability is moderately slow in the Williams soil and slow in the Noonan soil. Surface runoff is medium for both soils. Available water capacity is high in the Williams soil and moderate in the Noonan soil. These soils have a few stones on the surface that interfere with tillage and harvest operations. Root penetration is restricted by the dense, sodic subsoil in the Noonan soil at a depth of about 8 inches.

Most areas of this unit are used for cultivated crops or as rangeland. These soils are poorly suited to corn, flax, and small grain, and better suited to grasses and legumes for pasture and hay. There is a slight hazard of soil blowing and a serious hazard of water erosion. Tillage that leaves large amounts of crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Tillage that loosens the dense, sodic claypan in the Noonan soil or growing deep rooted crops, such as alfalfa or sweetclover, is beneficial to root and water penetration. Avoiding tillage when the soil is wet prevents crusting and the formation of hard clods that provide a poor seedbed. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility, maintain or improve soil tilth, and increase water infiltration.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

The Williams soil in this unit is suited to the trees and shrubs grown as windbreaks and environmental plantings. The Noonan soil is poorly suited to these uses. Root penetration is restricted in the Noonan soil by the sodic subsoil. Site selection, site preparation, and controlling competitive vegetation are important to the success of the planting.

These soils are suited to sites for buildings and are poorly suited to septic tank absorption fields. The shrinking and swelling in these soils is a limitation to sites for buildings. This can be overcome by using reinforced footings and basement walls and by providing good surface drainage by grading the surface away from the building. The permeability limits the use of these soils for septic tank absorption fields. This limitation can be overcome by enlarging the absorption field. The Williams soil in this unit is better suited to septic tank absorption fields than the Noonan soil.

This unit is in capability subclass IVe.

93C—Williams-Zahl loams, 6 to 9 percent slopes. These deep, gently rolling soils are well drained. They are on glacial till plains. Individual areas are irregular in shape and range from 5 acres to more than 100 acres in size. They are made up of about 50 percent Williams soils and 30 percent Zahl soils. The Williams soil is on side slopes, and the Zahl soil is on knobs. These soils are so intricately mixed or so small in size that it is not practical to separate them in mapping.

Typically, the Williams soil has a surface layer of dark grayish brown loam about 8 inches thick. The subsoil is clay loam about 15 inches thick. It is brown in the upper part and light brownish gray in the lower part. The substratum is light gray clay loam to a depth of 60 inches. In some places the soil has a surface layer of fine sandy loam or silt loam.

Typically, the Zahl soil has a surface layer of dark grayish brown loam about 5 inches thick. The substratum is pale olive clay loam to a depth of 60 inches.

Included with these soils in mapping are small areas of Amor, Arnegard, Cabba, and Noonan soils. Amor soils are on side slopes and are moderately deep. Cabba soils are shallow and are on hills and ridges. Arnegard soils have a thicker, darker colored surface layer. They are in swales. Noonan soils have a dense, sodic subsoil. They are in slight depressions. These included soils make up about 20 percent of the unit.

Permeability is moderately slow, surface runoff is medium, and available water capacity is high. These soils have a few stones on the surface that interfere with tillage and harvest operations.

Most areas of this unit are used for cultivated crops and as rangeland. These soils are suited to corn, flax, and small grain but are better suited to grasses and legumes for pasture and hay. There is a moderate hazard of soil blowing and a severe hazard of water erosion. Tillage that leaves large amounts of crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility, maintain or improve soil tilth, and increase water infiltration.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

The Williams soil in this unit is suited to the trees and shrubs grown as windbreaks and environmental plantings. The Zahl soil is poorly suited to these uses. Site selection, site preparation, and controlling competitive vegetation are important to the success of the planting.

This unit is suited to sites for buildings and is poorly suited to septic tank absorption fields. The shrinking and swelling of these soils is a limitation to sites for buildings. This can be overcome by using reinforced footings and basement walls and by providing good surface drainage by grading the surface away from the building. The moderately slow permeability limits the use of this soil for septic tank absorption fields. This limitation can be overcome by enlarging the absorption field.

This unit is in capability subclass IIIe.

93D—Zahl-Williams loams, 9 to 15 percent slopes. These deep, rolling soils are well drained. They are on glacial till plains. Individual areas are irregular in shape and range from 10 acres to more than 100 acres in size. They are made up of about 40 percent Zahl soils and 40 percent Williams soils. The Zahl soil is on knobs, and the Williams soil is on side slopes. These soils are so intricately mixed or so small in size that it is not practical to separate them in mapping.

Typically, the Zahl soil has a surface layer of dark grayish brown loam about 5 inches thick. The substratum is pale olive clay loam to a depth of 60 inches.

Typically, the Williams soil has a surface layer of dark grayish brown loam about 8 inches thick. The subsoil is clay loam about 15 inches thick. It is brown in the upper part and light brownish gray in the lower part. The substratum is light gray clay loam to a depth of 60 inches. In some places the soil has a surface layer of fine sandy loam or silt loam.

Included with these soils in mapping are small areas of Arnegard, Cabba, Noonan, and Rhoades soils. Arnegard soils have a thicker, darker colored surface layer. They

are in swales. Noonan and Rhoades soils have a dense, sodic subsoil. Noonan soils are in slight depressions, and Rhoades soils are in swales. Cabba soils are shallow. They are on hills and ridges. These included soils make up about 20 percent of the unit.

Permeability is moderately slow, surface runoff is rapid, and available water capacity is high. These soils have a few stones on the surface.

Most areas of this unit are used as rangeland, and they are better suited to this use. A few areas are used for cultivated crops. These soils are generally not suited to corn, flax, small grain, and grasses and legumes for pasture and hay. There is a moderate hazard of soil blowing and a severe hazard water erosion. Planting cultivated areas to grass helps prevent excessive soil losses. A cover of range plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing keep the range and soil in good condition.

The Williams soil in this unit is suited to the trees and shrubs grown as windbreaks and environmental plantings. The Zahl soil is generally not suited to these uses. Site preparation and controlling competitive vegetation are important to the success of the planting.

These soils are suited to sites for buildings and are poorly suited to septic tank absorption fields. The shrinking and swelling of these soils is a limitation to sites for buildings. This can be overcome by using reinforced footings and basement walls and by providing good surface drainage by grading the surface away from the building. The moderately slow permeability limits the use of the soils for septic tank absorption fields. This limitation can be overcome by enlarging the absorption field.

This unit is in capability subclass VIe.

93E—Zahl-Williams loams, 15 to 25 percent slopes. These deep, hilly soils are well drained. They are on glacial till plains. Individual areas are irregular in shape and range from 10 acres to more than 100 acres in size. They are made up of about 50 percent Zahl soils and 30 percent Williams soils. The Zahl soil is on knobs, and the Williams soil is on side slopes. These soils are so intricately mixed or so small in size that it is not practical to separate them in mapping.

Typically, the Zahl soil has a surface layer of dark grayish brown loam about 5 inches thick. The substratum is pale olive clay loam to a depth of 60 inches.

Typically, the Williams soil has a surface layer of dark grayish brown loam about 8 inches thick. The subsoil is clay loam about 15 inches thick. It is brown in the upper part and light brownish gray in the lower part. The substratum is light gray clay loam to a depth of 60 inches. In some places the soil has a surface layer of silt loam or fine sandy loam.

Included with these soils in mapping are areas of Arnegard, Cabba, Noonan, and Rhoades soils. Arnegard soils have a thicker, darker colored surface layer. They are in swales. Noonan and Rhoades soils have a dense, sodic subsoil. Noonan soils are in slight depressions; Rhoades soils are in swales. Cabba soils are shallow. They are on hills and ridges. These included soils make up about 20 percent of the unit.

Permeability is moderately slow, surface runoff is rapid, and available water capacity is high. These soils have a few stones on the surface.

Most areas of this unit are used as rangeland and are better suited to this use. A few areas are used for cultivated crops. This unit is generally not suited to corn, flax, and small grain; grasses and legumes for pasture and hay; or to the trees and shrubs grown as windbreaks and environmental plantings. There is a very severe hazard of water erosion and a moderate hazard of soil blowing. Planting cultivated areas to grass helps prevent excessive soil losses. A cover of range plants is effective in controlling erosion. Overstocking or overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

These soils are poorly suited to sites for buildings and to septic tank absorption fields. The shrinking and swelling of these soils is a limitation to sites for buildings. This can be overcome by using reinforced footings and basement walls and by providing good surface drainage by grading the surface away from the building. Buildings should be designed to conform to the natural slope of the land. Land shaping may be needed in some areas. The moderately slow permeability limits the use of these soils for septic tank absorption fields. This limitation can be overcome by enlarging the absorption field. The slope also is a limitation for septic tank absorption fields. It can be overcome by installing the absorption field on the contour.

This unit is in capability subclass VIe.

94B—Moreau Variant clay loam, 1 to 6 percent slopes. This shallow, nearly level and gently sloping soil is moderately well drained. It is on uplands. Individual areas are irregular in shape and range from 5 acres to more than 100 acres in size.

Typically, the surface layer is light brownish gray clay loam about 6 inches thick. The subsoil is grayish brown silty clay about 6 inches thick. The substratum is gray silty clay loam to a depth of about 17 inches. Below this is soft bedrock. In some places the soil is more than 20 inches deep to soft bedrock.

Included with this soil in mapping are small areas of Lefor and Rhoades soils. Lefor soils have more sand, are moderately deep to soft bedrock, and are on side slopes. Rhoades soils have a dense, sodic subsoil. They

are in swales. These included soils make up about 10 percent of the unit.

Permeability is slow, surface runoff is medium, and available water capacity is low. Root penetration is restricted by soft bedrock at a depth of about 17 inches. The surface layer is friable and easily tilled when moist but becomes hard and cloddy if tilled when too wet or too dry.

Most areas of this soil are used for cultivated crops. This soil is poorly suited to corn, flax, and small grain. It is better suited to grasses and legumes for hay and pasture and is generally not suited to the trees and shrubs grown as windbreaks and environmental plantings. There is a slight hazard of soil blowing and a moderate hazard of water erosion. Tillage that leaves moderate amounts of crop residue on the surface, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility, maintain or improve soil tilth, and increase water infiltration.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This soil is poorly suited to sites for buildings and is generally not suited to septic tank absorption fields. The shrinking and swelling of the soil is a limitation to sites for buildings. This can be overcome by using reinforced footings and basement walls and by providing good surface drainage by grading the surface away from the building. The depth to rock limits the use of the soil for septic tank absorption fields. This limitation is difficult to overcome. Effluent from septic tank absorption fields can follow bedding planes in the bedrock and can surface downslope or can contaminate ground water. Alternative systems of disposal, such as holding tanks, should be considered.

This soil is in capability subclass IVe.

94E—Wayden silty clay, 9 to 25 percent slopes. This shallow, strongly sloping and moderately steep soil is well drained. It is on uplands. Individual areas are linear or irregular in shape and range from 10 acres to about 100 acres in size.

Typically, the surface layer is grayish brown silty clay about 4 inches thick. The substratum is grayish brown silty clay to a depth of 16 inches. Below this is soft bedrock. In some places the soil has more sand, and in other places it is moderately deep.

Included with this soil in mapping are small areas of Rhoades soils. Rhoades soils have a dense, sodic subsoil. They are in swales. Also included are some very stony soils and a few areas of rock outcrop. These included soils make up about 10 percent of the unit.

Permeability is slow, surface runoff is very rapid, and available water capacity is very low. Root penetration is restricted by soft bedrock at a depth of about 16 inches.

Most areas of this soil are used as rangeland and are better suited to this use. This soil is generally not suited to corn, flax, small grain, trees and shrubs grown as windbreaks and environmental plantings, or grasses and legumes for pasture and hay. There is a moderate hazard of soil blowing and a very severe hazard of water erosion. A cover of range plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This soil is generally not suited to sites for buildings and to septic tank absorption fields. Better sites are generally nearby.

This soil is in capability subclass VIIe.

101B—Amor loam, 3 to 6 percent slopes. This moderately deep, gently sloping soil is well drained. It is on side slopes and foot slopes of uplands. Individual areas are irregular in shape and range from 5 acres to more than 100 acres in size.

Typically, the surface layer is dark grayish brown loam about 7 inches thick. The subsoil is very fine sandy loam about 14 inches thick. It is dark brown in the upper part and brown in the lower part. The substratum is light brownish gray loam to a depth of about 34 inches. Below this is soft bedrock. In some places the soil has a subsoil of silty clay loam, and in other places it is more than 40 inches deep to bedrock.

Included with this soil in mapping are small areas of Rhoades and Vebar soils. Rhoades soils have a dense, sodic subsoil. They are in swales. Vebar soils have a surface layer and subsoil of fine sandy loam. They are on side slopes. These included soils make up about 15 percent of the unit.

Permeability and available water capacity are moderate, and surface runoff is medium. Root penetration is somewhat restricted by soft bedrock at a depth of about 34 inches. The surface layer is friable and easily tilled throughout a wide range in moisture content.

Most areas of this soil are used for cultivated crops. This soil is well suited to corn, flax, small grain, and grasses and legumes for hay and pasture. There is a slight hazard of soil blowing and a moderate hazard of water erosion. Tillage that leaves moderate amounts of crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility, maintain or improve soil tilth, and increase water infiltration.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Amor soil is well suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation and controlling competitive vegetation are important to the success of the planting.

This soil is suited to sites for buildings and is poorly suited to septic tank absorption fields. The shrinking and swelling of this soil is a limitation to sites for buildings. This can be overcome by using reinforced footings and basement walls and by providing good surface drainage by grading the surface away from the building. The depth to bedrock limits the use of the soil for septic tank absorption fields. This limitation is difficult to overcome. Effluent from septic tank absorption fields can follow bedding planes in the bedrock and can surface downslope or can contaminate ground water. Alternative systems of disposal should be considered.

This soil is in capability subclass IIe.

101C—Amor loam, 6 to 9 percent slopes. This moderately deep, moderately sloping soil is well drained. It is on side slopes of uplands. Individual areas are irregular in shape and range from 5 acres to more than 100 acres in size.

Typically, the surface layer is dark grayish brown loam about 7 inches thick. The subsoil is very fine sandy loam about 14 inches thick. It is dark brown in the upper part and brown in the lower part. The substratum is light brownish gray loam to a depth of about 34 inches. Below this is soft bedrock. In some places the soil has a subsoil of silty clay loam, and in other places it is more than 40 inches deep to bedrock.

Included with this soil in mapping are small areas of Rhoades and Vebar soils. Rhoades soils have a dense, sodic subsoil. They are in swales. Vebar soils have a surface layer and subsoil of fine sandy loam. They are on side slopes. These included soils make up about 15 percent of the unit.

Permeability and available water capacity are moderate, and surface runoff is medium. Root penetration is somewhat restricted by soft bedrock at a depth of about 34 inches. The surface layer is friable and easily tilled throughout a wide range in moisture content.

Most areas of this soil are used for cultivated crops. This soil is suited to corn, flax, small grain, and grasses and legumes for pasture and hay. There is a slight hazard of soil blowing and a severe hazard of water erosion. Tillage that leaves large amounts of crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility, maintain or improve soil tilth, and increase water infiltration.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Amor soil is well suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation and controlling competitive vegetation are important to the success of the planting.

This soil is suited to sites for buildings and is poorly suited to septic tank absorption fields. The shrinking and swelling of this soil is a limitation to sites for buildings. This can be overcome by using reinforced footings and basement walls and by providing good surface drainage by grading the surface away from the building. The depth to rock limits the use of this soil for septic tank absorption fields. This limitation is difficult to overcome. Effluent from septic tank absorption fields can follow bedding planes in the bedrock and can surface downslope or can contaminate ground water. Alternative systems of disposal should be considered.

This soil is in capability subclass IIIe.

102—Shambo loam, 1 to 3 percent slopes. This deep, nearly level soil is well drained. It is on alluvial fans and terraces. Many areas are dissected by shallow drainageways. Individual areas are irregular in shape and range from 5 acres to more than 100 acres in size.

Typically, the surface layer is dark grayish brown loam about 4 inches thick. The subsoil is about 28 inches thick. It is dark grayish brown loam in the upper part, grayish brown silt loam in the middle part, and light olive brown loam in the lower part. The substratum to a depth of 60 inches is light brownish gray loam in the upper part, light gray loam in the middle part, and light gray silt loam in the lower part. In some places the soil has a thicker, darker colored surface layer, and in other places it has more clay. In a few places the substratum is gravelly.

Included with this soil in mapping are small areas of Amor, Belfield, Hidatsa, and Morton soils. Amor and Morton soils are moderately deep to soft bedrock. They are on side slopes. Belfield soils have a sodic subsoil. They are in swales. Hidatsa soils have a very gravelly substratum. They are on terraces and fans. These included soils make up about 15 percent of the unit.

Permeability is moderate, surface runoff is slow, and available water capacity is high. The surface layer is friable and easily tilled throughout a wide range in moisture content.

Most areas of this soil are used for cultivated crops. This soil is well suited to corn, flax, small grain, and grasses and legumes for pasture and hay. There is a

moderate hazard of soil blowing and a slight hazard of water erosion. Tillage that leaves moderate amounts of crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility, maintain or improve soil tilth, and increase water infiltration.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Shambo soil is well suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation and controlling competitive vegetation are important to the success of the planting.

This soil is suited to sites for buildings and to septic tank absorption fields. The shrinking and swelling of the soil is a limitation to sites for buildings. This can be overcome by using reinforced footings and basement walls and by providing good surface drainage by grading the surface away from the building. The moderate permeability limits the use of the soil for septic tank absorption fields. This limitation can be overcome by enlarging the size of the absorption field.

This soil is in capability subclass IIc.

102B—Shambo loam, 3 to 6 percent slopes. This deep, gently sloping soil is well drained. It is on alluvial fans and terraces. Many areas are dissected by shallow drainageways. Individual areas are irregular in shape and range from 5 acres to more than 100 acres in size.

Typically, the surface layer is dark grayish brown loam about 4 inches thick. The subsoil is about 28 inches thick. It is dark grayish brown loam in the upper part, grayish brown silt loam in the middle part, and light olive brown loam in the lower part. The substratum to a depth of 60 inches is light brownish gray loam in the upper part, light gray loam in the middle part, and light gray silt loam in the lower part. In some places the soil has a thicker, darker colored surface layer, and in other places it has more clay in the subsoil. In a few places the substratum is gravelly.

Included with this soil in mapping are small areas of Amor, Belfield, Hidatsa, and Morton soils. Amor and Morton soils are moderately deep to soft bedrock. They are on side slopes. Belfield soils have a sodic subsoil. They are in swales. Hidatsa soils have a very gravelly substratum. They are on fans and terraces. These included soils make up about 15 percent of the unit.

Permeability is moderate, surface runoff is medium, and available water capacity is high. The surface layer is friable and easily tilled throughout a wide range in moisture content.

Most areas of this soil are used for cultivated crops. This soil is well suited to corn, flax, small grain, and grasses and legumes for pasture and hay. There is a slight hazard of soil blowing and a moderate hazard of water erosion. Tillage that leaves moderate amounts of crop residue on the surface, field windbreaks, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility, maintain or improve soil tilth, and increase water infiltration.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Shambo soil is well suited to the trees and shrubs grown as windbreaks and environmental plantings. Site preparation and controlling competitive vegetation are important to the success of the planting.

This soil is suited to sites for buildings and septic tank absorption fields. The shrinking and swelling of the soil is a limitation to sites for buildings. This can be overcome by using reinforced footings and basement walls and by providing good drainage by grading the surface away from the building. The moderate permeability limits the use of this soil for septic tank absorption fields. This limitation can be overcome by enlarging the size of the absorption field.

This soil is in capability subclass IIe.

105—Harriet silt loam. This deep, nearly level soil is poorly drained. It is on terraces and flood plains. Slope is 0 to 1 percent. This soil is occasionally flooded. Individual areas are linear in shape and range from 5 acres to about 200 acres in size.

Typically, the surface layer is gray silt loam about 2 inches thick. The subsoil is grayish brown silty clay loam about 8 inches thick. The substratum to a depth of 60 inches is grayish brown silty clay loam and silty clay in the upper part and light olive gray, stratified silty clay and sandy clay loam in the lower part. In some places the soil has a layer of lime accumulation within 16 inches of the surface.

Included with this soil in mapping are small areas of very poorly drained Dimmick soils, moderately well drained Rhoades soils, and well drained Farland and Straw soils. Dimmick, Farland, and Straw soils do not have a sodic subsoil. Dimmick soils are in depressions, Farland soils are on terraces, and Straw and Rhoades soils are on slightly higher positions of the landscape. These included soils make up about 10 percent of the unit.

Permeability is very slow, surface runoff is slow, and available water capacity is moderate. Root penetration is somewhat restricted by the sodic subsoil at a depth of

about 2 inches. This soil has a seasonal high water table.

Most areas of this soil are used as rangeland. This soil is not suited to the trees and shrubs grown as windbreaks and environmental plantings or to crops because of the excess sodium content, the seasonal high water table, the salt content, and the flooding. There is a slight hazard of soil blowing and water erosion. A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and deferred grazing help keep the range and soil in good condition. Grazing should be restricted during wet periods to prevent damage to the soil and vegetation.

This soil is suited to wetland wildlife habitat. Management practices that regulate livestock use and maintaining a buffer strip of vegetation surrounding the unit prevent siltation and damage to the wetland habitat. Many areas are surrounded by soils that are suited to vegetation that supports wetland wildlife species.

This soil is not suited to sites for buildings and to septic tank absorption fields because of the seasonal high water table, the occasional flooding, and the very slow permeability. Better sites are generally nearby.

This soil is in capability subclass VIw.

106B—Daglum silt loam, 1 to 6 percent slopes. This deep, nearly level and gently sloping soil is moderately well drained (fig. 12). It is on uplands. Individual areas are irregular in shape and range from 5 acres to about 100 acres in size.

Typically, the surface layer is grayish brown silt loam about 4 inches thick. The subsurface layer is grayish

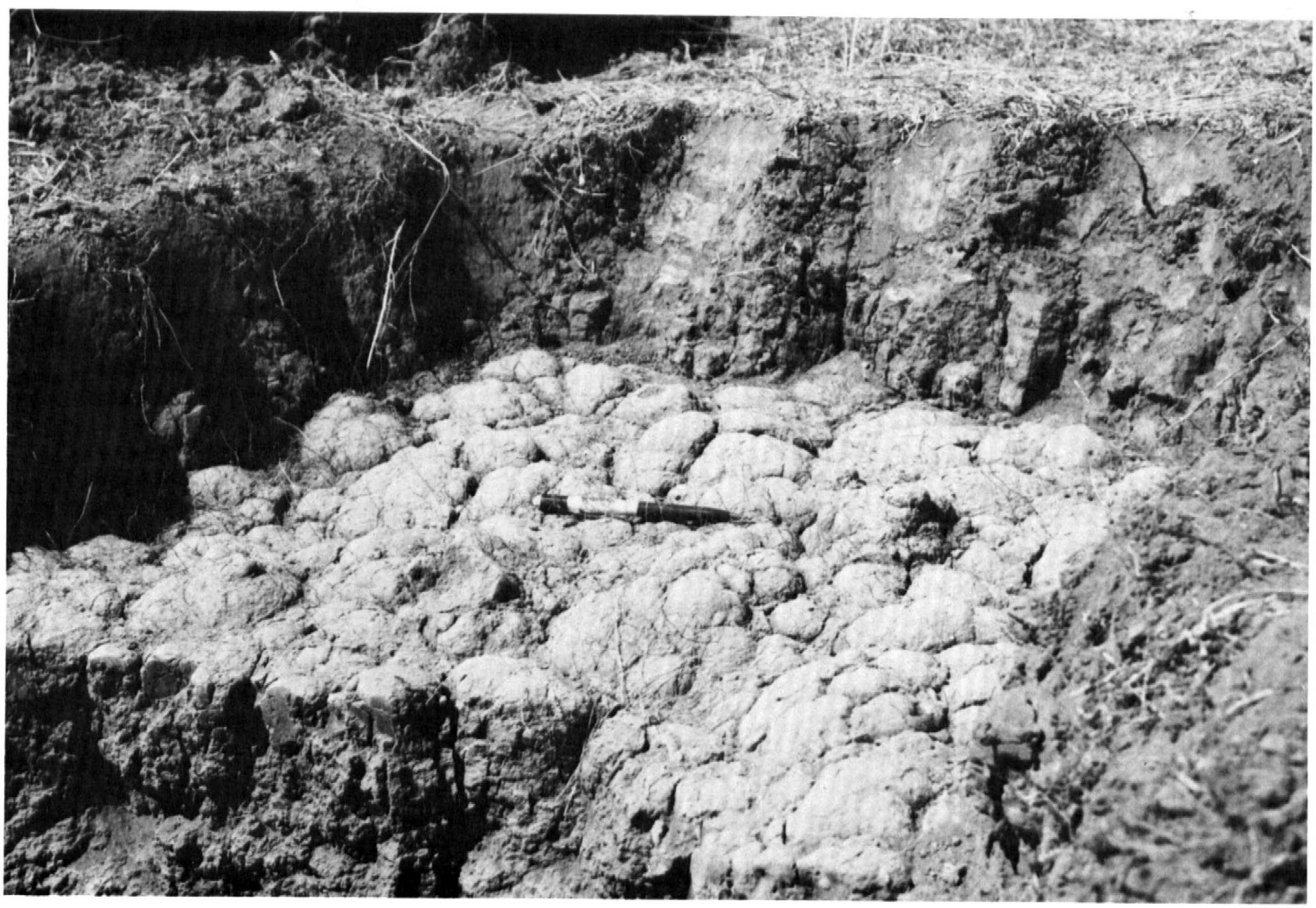


Figure 12.—Removing the surface layer of Daglum silt loam exposes the light colored subsurface layer and the subsoil. The rounded tops of columnar structural aggregates are evident in the subsoil.

brown silt loam about 3 inches thick. The subsoil is silty clay loam about 11 inches thick. It is dark grayish brown in the upper part and grayish brown in the lower part. The substratum to a depth of 46 inches is light brownish gray silty clay loam in the upper part, grayish brown clay loam in middle part, and light brownish gray silty clay in the lower part. Below this is soft bedrock. In some places the surface layer is thinner and fine sandy loam, and in a few places it is thicker.

Included with this soil in mapping are small areas of Farland, Morton, Regent, and Savage soils. Those soils do not have a sodic subsoil. Morton and Regent soils are on side slopes. Farland soils are on terraces, and Savage soils are on foot slopes. These included soils make up about 15 percent of the unit.

Permeability is very slow, surface runoff is slow, and available water capacity is moderate. Root penetration is restricted by the sodic subsoil at a depth of about 7 inches.

Most areas of this soil are used for cultivated crops or as rangeland. This soil is poorly suited to corn, flax, and small grain and is better suited to grasses and legumes for pasture and hay. There is a slight hazard of soil blowing and water erosion. Tillage that leaves crop residue on the surface, stripcropping, grassed waterways, and diversions help prevent excessive soil loss. Tillage that loosens the sodic subsoil or growing deep rooted crops, such as alfalfa or sweetclover, allows root and water penetration. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility, improve soil tilth, and increase water infiltration. Avoiding tillage when the soil is wet helps prevent crusting and the formation of hard clods that make a poor seedbed.

A cover of range, hay, or pasture plants are effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Daglum soil is poorly suited to the trees and shrubs grown as windbreaks and environmental plantings. Root penetration is restricted by the dense, sodic subsoil. Site preparation, the soil's lying fallow the year preceding planting, and controlling competitive vegetation help insure success of the planting.

This soil is poorly suited to sites for buildings and generally is not suited to septic tank absorption fields. The shrinking and swelling of the soil is a limitation to sites for buildings. This can be overcome by using reinforced footings and basement walls and by providing good drainage by grading the surface away from the building. The slow permeability limits the use of this soil for septic tank absorption fields. This limitation is difficult to overcome. Better sites are generally nearby.

This soil is in capability subclass IVs.

107—Aquents, ponded. These deep, level soils are very poorly drained. They are in depressions. Slope is 0 to 1 percent. The soil is permanently ponded, except in dry years. Individual areas are oval or circular in shape and range from 5 acres to more than 600 acres in size.

Typically, about 3 inches of partially decomposed organic material is on the surface layer. The surface layer is gray clay about 20 inches thick. The substratum is gray clay to a depth of 60 inches.

Included with these soils in mapping are small areas of Harriet, Heil, and Rhoades soils. These soils are better drained and have a dense, sodic subsoil. Harriet, Heil, and Rhoades soils are on the outer edge of depressions. These included soils make up about 10 percent of the unit.

Permeability is very slow, available water capacity is high, and surface runoff is ponded. These soils have a high water table.

Most areas of these soils are used for sources of livestock water and wetland wildlife habitat. They are not suited to cultivated crops, the trees and shrubs grown as windbreaks and environmental plantings, or range plants because the surface is ponded. These soils are well suited to wetland wildlife habitat. The natural vegetation is cattail, bulrush, and reeds. Management practices which regulate livestock use and which maintain a buffer strip of vegetation surrounding the area prevent siltation and damage to the wetland habitat.

These soils are not suited to sites for buildings and to septic tank absorption fields because of ponding, very slow permeability, high shrink-swell potential, and a high water table. Better sites are generally nearby.

This unit is in capability subclass VIIIw.

109B—Ekalaka fine sandy loam, 1 to 6 percent slopes. This deep, nearly level and gently sloping soil is moderately well drained. It is on uplands. Individual areas are irregular in shape and range from 5 acres to about 50 acres in size.

Typically, the surface layer is fine sandy loam about 11 inches thick. It is grayish brown in the upper part and dark grayish brown in the lower part. The subsurface layer is light gray loamy fine sand about 2 inches thick. The subsoil is mottled light brownish gray fine sandy loam about 8 inches thick. The substratum is fine sandy loam to a depth of 60 inches. It is mottled light brownish gray, yellowish brown, and strong brown. Below this is soft sandstone. In some places the soil has more clay.

Included with this soil in mapping are small areas of Harriet, Parshall, Rhoades, and Vebar soils. Harriet soils are poorly drained. They are on flood plains. Parshall soils do not have a sodic subsoil. They are in swales. Rhoades soils have a subsoil of silty clay loam. They are in swales. These included soils make up about 10 percent of the unit.

Permeability and surface runoff are slow, and available water capacity is low. Root penetration is restricted by

the dense, sodic subsoil at a depth of about 13 inches. The surface layer is friable and easily worked throughout a wide range in moisture content.

Most areas of this soil are used for cultivated crops or as rangeland. This soil is poorly suited to corn, flax, and small grain and is better suited for grasses and legumes for pasture and hay. There is a severe hazard of soil blowing and a moderate hazard of water erosion. Tillage that leaves large amounts of crop residue on the surface, cover crops, minimum summer fallow, grassed waterways, and diversions help prevent excessive soil loss. Tillage that loosens the sodic subsoil or growing deep rooted crops, such as alfalfa or sweetclover, is beneficial to the penetration of roots and water. Returning crop residue to the surface or the addition of other organic material into the plow layer helps improve fertility, maintain soil tilth, and increase water infiltration.

A cover of range, hay, or pasture plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

This Ekalaka soil is suited to some of the trees and shrubs grown as windbreaks and environmental plantings. Site preparation, the soil's lying fallow the year preceding planting, and controlling competitive vegetation are important to the success of the planting.

This soil is suited to sites for buildings and is poorly suited to septic tank absorption fields. The slow permeability limits the use of this soil for septic tanks. This limitation can be overcome by enlarging the absorption field.

This soil is in capability subclass IVe.

207F—Arikara loam, 9 to 75 percent slopes. This deep, strongly sloping to very steep soil is well drained. It is on side slopes of uplands. Individual areas of this unit are irregular or linear in shape and range from 50 acres to about 300 acres in size.

Typically, the Arikara soils have a 1-inch layer of woodland litter on the surface. The surface layer is dark gray loam about 1 inch thick. The subsoil is grayish brown about 12 inches thick. It is loam in the upper part and clay loam in the lower part. The substratum to a depth of about 60 inches is light brownish gray loam in the upper part, light yellowish brown loam in the middle part, and light yellowish brown fine sandy loam in the lower part. In some places the soil has a thicker, darker colored surface layer, and in a few places it has a gray, leached subsurface layer.

Included with this soil in mapping are small areas of Badland and areas of Cabba, Cherry, and Rhoades soils. Badland consists of bare, weathered, soft shale. Cabba soils are shallow to soft bedrock. They are on hills and ridges. Cherry soils have a surface layer of silty clay loam. They are on foot slopes and fans. Rhoades soils have a dense, sodic subsoil. They are in swales. These included soils make up about 15 percent of the unit.

Permeability is moderate, surface runoff is rapid, and available water capacity is high.

Most areas of this soil are used as rangeland or for wildlife habitat, and they are better suited to these uses. This soil is not suited to cultivated crops, hay, or pasture. Grazing is limited to sparse stands of grass under the trees. These wooded areas are valued as summer shade and winter protection for livestock. Overstocking and overgrazing damage the organic layer on the soil surface and reduce the protective vegetative cover. Proper stocking rates, pasture rotation and timely deferred grazing help keep the woodland, pasture, soil, and the wildlife habitat in good condition.

The woodland cover includes bur oak, green ash, American elm, quaking aspen, juneberry, gooseberry, and prairie rose. It produces a diversity of food and cover for wildlife.

This unit is generally not suited to sites for buildings and to septic tank absorption fields. In the survey area this soil is not used for these uses. Better sites are generally nearby.

This soil is in capability subclass VIIe.

209E—Cherry-Cabba complex, 9 to 25 percent slopes. These deep and shallow, strongly sloping and moderately steep soils are well drained. They are on uplands. In most areas the soil is subject to slippage. Individual areas are irregular in shape and range from 20 acres to about 200 acres in size. They are made up of about 50 percent Cherry soils and 25 percent Cabba soils. The Cherry soil is on fans and foot slopes, and the Cabba soil is on hills and ridges. These soils are so intricately mixed or so small in size that it is not practical to separate them in mapping.

Typically, the Cherry soil has a surface layer of grayish brown silty clay loam about 4 inches thick. The subsoil is light brownish gray silty clay loam about 22 inches thick. The substratum is light brownish gray to a depth of 60 inches. It is silty clay loam in the upper part and stratified silty clay, silty clay loam, and silt loam in the lower part. In some places the soil does not have a subsoil.

Typically, the Cabba soil has a surface layer of grayish brown loam about 3 inches thick. The next layer is light brownish gray silt loam about 5 inches thick. The substratum is grayish brown silt loam to a depth of 18 inches. Below this is soft bedrock. In some places the soil has a surface layer of fine sandy loam or silt loam.

Included with these soils in mapping are small areas of Amor, Arikara, Arnegard, Rhoades, Vanda, and Vebar soils and areas of Badland. Arikara soils are deep and have a subsoil of loam and clay loam. Amor and Vebar soils are moderately deep to soft bedrock. The Arikara, Amor, and Vebar soils are on side slopes. Arnegard soils have a thicker, darker colored surface layer, and Rhoades soils have a dense, sodic subsoil. Both soils

are in swales. Vanda soils have a surface layer of silty clay. They are on fans. Badland consists of bare, weathered, soft bedrock. These included soils make up about 25 percent of the unit.

Permeability is moderately slow in the Cherry soil and moderate in the Cabba soil. Surface runoff is rapid for both soils. Available water capacity is high in the Cherry soil and very low in the Cabba soil. Rooting depth is somewhat restricted in the Cabba soil by soft bedrock at a depth of about 18 inches.

Most areas of this unit are used as rangeland or for wildlife habitat. These soils are better suited to rangeland. A cover of range plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and soil in good condition.

These soils are generally not suited to sites for buildings and to septic tank absorption fields because of slippage and the hazard of continuing slippage. Better sites are generally nearby.

This unit is in capability subclass VIe.

211F—Badland-Cabba-Arikara complex, 25 to 120 percent slopes. This unit consists of miscellaneous areas of Badland in a complex with shallow and deep, steep and very steep soils that are well drained. The unit is on uplands. Most areas are dissected by many intermittent drainageways. Local relief ranges between 100 and 600 feet. Individual areas of this unit are irregular in shape and range from 100 acres to more than 1,000 acres in size. They are made up of about 30 percent Badland areas, 30 percent Cabba soils, and 15 percent Arikara soils. The Badland and the Arikara soil are on side slopes, and the Cabba soil is on hills and ridges. The Badland and soils are so intricately mixed or so small in size that it is not practical to separate them in mapping.

The Badland areas consist of exposed, eroding soft bedrock that is silty and clayey. Badland, typically, is drier and on the south-facing slopes.

Typically, the Cabba soil has a surface layer of grayish brown loam about 3 inches thick. The next layer is light brownish gray silt loam about 5 inches thick. The substratum is grayish brown silt loam to a depth of 18 inches. Below this is soft bedrock. In some places the soil is fine sandy loam or silt loam, and in a few places it is underlain by porcelanite.

Typically, the Arikara soil has a 1-inch layer of woodland litter on the surface. The surface layer is dark gray loam about 1 inch thick. The subsoil is grayish brown about 12 inches thick. It is loam in the upper part and clay loam in the lower part. The substratum to a depth of 60 inches is light brownish gray loam in the upper part, light yellowish brown loam in the middle part, and light yellowish brown fine sandy loam in the lower part. In some places the soil has a thicker, darker colored surface layer and in a few places it has a gray, leached subsurface layer.

Included with this unit in mapping are small areas of Cherry, Havrelon, Vanda, and Vebar soils. Cherry soils have a surface layer of silty clay loam, and Vanda soils have a surface layer of silty clay. Both soils are on fans. Havrelon soils have a surface layer of silt loam and are subject to flooding. They are on flood plains. Vebar soils are moderately deep and have a surface layer of fine sandy loam. They are on side slopes. These included soils make up about 25 percent of the unit.

Permeability is moderate in the Cabba and Arikara soils. Surface runoff is very rapid. Available water capacity is high in the Arikara soil and very low in the Cabba soil. Root penetration is somewhat restricted in the Cabba soil by bedrock at a depth of about 18 inches. Slippage and downslope movement of these soils are common in all areas of the unit.

Most areas of this unit are used as rangeland or for wildlife habitat. They are best suited to rangeland, rangeland wildlife habitat, and woodland wildlife habitat. These soils are generally not suited to cultivated crops, hay, pasture, openland wildlife habitat, or the trees and shrubs grown as windbreaks and environmental plantings. A cover of range and woodland plants is effective in controlling erosion. Overstocking and overgrazing the range reduce the protective vegetative cover and cause deterioration of the desired plant community. Proper stocking rates, pasture rotation, and timely deferred grazing help keep the range and wildlife habitat in good condition.

This unit is generally not suited to sites for buildings and to septic tank absorption fields because of the hazard of slippage.

This unit is in capability subclass VIIe.

prime farmland

Prime farmland is one of several kinds of important farmlands defined by the U.S. Department of Agriculture. It is of major importance in providing the nation's short- and long-range needs for food and fiber. The supply of high quality farmland is limited, and the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, must encourage and facilitate the use of our nation's prime farmland with wisdom and foresight.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to producing food, feed, forage, fiber, and oilseed crops. It has the soil quality, growing season, and moisture supply needed to economically produce a sustained high yield of crops when it is treated and managed using acceptable farming methods. Prime farmland produces the highest yields with minimal inputs of energy and economic

resources, and farming it results in the least damage to the environment.

Prime farmland may now be in crops, pasture, woodland, or other land, but not urban and built-up land or water areas. It must either be used for producing food or fiber or be available for these uses.

Prime farmland usually has an adequate and dependable supply of moisture from precipitation or irrigation. It also has favorable temperature and growing season, acceptable acidity or alkalinity. It has few or no rocks and is permeable to water and air. Prime farmland is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. For more detailed information on the criteria for prime farmland consult the local staff of the Soil Conservation Service.

About 52,780 acres, or nearly 4 percent, of Dunn County meets the soil requirements for prime farmland.

Soil map units that make up prime farmland in Dunn County are listed in this section. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in Table 4. The location is shown on the detailed soil maps in the back of this publication. The soil qualities that affect use and management are described in the section "Detailed soil map units."

4—Arnegard loam, 1 to 3 percent slopes
4B—Arnegard loam, 3 to 6 percent slopes
33—Grail silt loam, 1 to 3 percent slopes
33B—Grail silt loam, 3 to 6 percent slopes
75—Straw loam

use and management of the soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

crops and pasture

This section was prepared by Edward R. Weimer, agronomist, Soil Conservation Service.

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops and hay and pasture plants are listed for each soil (See Table 5).

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed soil map units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

The amount of acreage in close-grown crops has been increasing. At the same time the acreage in pasture, range, and summer fallow has been decreasing. This has mainly been the result of higher grain prices and changes in weather patterns. Much of the range being converted to cropland is on the Fort Berthold Indian Reservation.

The potential of the soils in Dunn County for increased production of food and fiber is good. Production could be increased by extending the latest crop production technology to all cropland in the county. This soil survey can facilitate the application of such technology.

In 1979, about 182,400 acres in Dunn County were used for close-grown crops, mainly wheat, barley, and oats according to the 1980 North Dakota Agricultural Statistics of the North Dakota State University Agricultural Experiment Station and the U.S. Department of Agriculture, Economics, Statistics and Cooperative Service. Other crops grown in 1979 were sunflowers, on 9,100 acres; corn for silage, on 15,000 acres; and hay, on 131,500 acres. About 106,000 acres, or 31 percent of the farmland, was in summer fallow.

The soils and climate of the survey area are suited to most crops commonly grown in the area, including wheat, barley, oats, sunflowers, corn for silage, flax, rye, legumes, and tame grasses. Crops not commonly grown, but suitable include potatoes; mustard; safflower; dry edible beans, such as pinto beans; and buckwheat.

The main management needs of the soils are controlling soil blowing and water erosion, conserving moisture, and maintaining fertility.

Soil blowing is a hazard on nearly all soils of the county but is most severe on the moderately coarse and coarse textured Vebar, Flaxton, Lefor, Lihen, Ruso, Parshall, Velva, and Banks soils. Soil blowing can damage these soils in a very short time when they are farmed in large blocks or wide fields and if winds are strong and the soils are dry and bare of vegetation or surface mulch. The soils that are moderately susceptible

to soil blowing include the fine textured Lawther soils and the medium and moderately fine textured Chama, Havrelon, and Moreau soils, which have a high percent of lime in the surface layer. Water erosion is a hazard mainly on the gently sloping and steeper soils. The principal soils that are subject to water erosion are Morton, Regent, Cabba, Amor, Cherry, Farland, Shambo, Chama, Williams, Moreau, Temvik, Watrous, Savage, Searing, Sen, and Zahl.

Among measures that help to control soil blowing and water erosion are growing cover crops, stripcropping, planting buffer strips, establishing windbreaks, contour tillage, constructing diversions and waterways, keeping tillage to a minimum, timely and emergency tillage, growing grasses and legumes in the cropping system, and using crop residue. A combination of several measures generally is used.

Moisture generally is conserved by reducing evaporation, limiting runoff, increasing infiltration, and controlling weeds. Among the effective practices are stubble mulching, contour tillage, stripcropping, field windbreaks, buffer strips, keeping tillage timely and to a minimum, growing grasses and legumes in the cropping system, maintaining crop residue on the surface, and applying fertilizer. Periods of fallow help to control weeds and to store available moisture in the soil.

Among the measures that help to maintain fertility are the application of fertilizer; plowing green manure and barnyard manure into the soil; and the inclusion of cover crops, grasses, and legumes in the cropping system. Most practices that help to control soil blowing and water erosion also help to maintain fertility.

To offset the effects of unfavorable soil characteristics in some soils, claypans in the subsoil need to be broken up, stones need to be removed, and salinity needs to be reduced. Deep plowing helps break up and mix claypans in the Rhoades, Daglum, Noonan, and Belfield soils. Some removal of stones is usually necessary in soils formed in till, such as Williams and Flaxton soils. Practices that benefit saline soils include eliminating summer fallow, growing the most salt-tolerant grain crops, use of green-manure crops, and growing tame and native grasses.

Some common conservation practices, such as incorporating green manure into the soil or growing grasses and legumes in the cropping system, help to maintain good tilth. Heavy textured soils, such as Lawther silty clay, often are plowed in the fall at the right moisture content to maintain tilth and form a good seedbed.

yields per acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that insures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 5 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils.

land capability classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have slight limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation (fig. 13).

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability class and subclass of each map unit is given in the section "Detailed soil map units."

Figure 13.—Class IIe and IIIe soils, foreground, protected from erosion by small grain stubble; Class IVe soils, middle ground, are protected by hay; Class VIe and VIIe soils, background, protected by range grasses.

rangeland

This section was prepared by Brian D. Gerbig, range conservationist, Soil Conservation Service.

About 55 percent of Dunn County is range. Cow-calf yearling operations are a major source of farm and ranch income. According to the 1980 North Dakota Agricultural Statistics, there were 86,000 range cattle and 2,000 milk cows in the county. The forage produced on much of the range is supplemented by crop stubble and tame pasture. During the winter the native forage is supplemented by hay, feed grains, and protein concentrate.

Much of the native range remaining in Dunn County is growing on soils that have characteristics that limit their use as cropland or strongly influence natural vegetation. For example, Rhoades soils are better suited to rangeland than to cropland because of the dense claypan subsoil. Total annual production on the soils that have a claypan is low because permeability, fertility, and available water capacity are unfavorable. The high concentration of salts in the Rhoades soils also adversely affects plant growth. The annual range forage production on the Badland-Cabba-Arikara complex, some of the most extensive range areas along the Little Missouri River, is limited by low available water capacity of the soil and runoff from the steep soils.

Water erosion is a hazard on overgrazed rangeland that does not have a good vegetation cover and does not have surface mulch to reduce the runoff.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

Table 6 shows, for each soil the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the average percentage of each species. Only those soils that are used as or are suited to rangeland are listed. Explanation of the column headings in table 6 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was ascertained during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Total production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Dry weight is the total annual yield per acre reduced to a common percent of air-dry moisture.

Characteristic vegetation—the grasses, forbs, and shrubs that make up most of the potential natural plant community on each soil—is listed by common name. Under *composition*, the expected percentage of the total annual production is given for each species making up the characteristic vegetation. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, reduction of undesirable brush species, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

In Dunn County, much of the native forage production has been reduced because continued overuse has altered the natural vegetation. Forage management and animal control practices are necessary to increase desirable species while reducing undesirable ones.

Good forage management includes proper stocking rates, deferred grazing, and planned systems of grazing. Animal control practices, such as fencing, watering developments, placement of salt, and livestock pest control assist in obtaining optimum uniform distribution of grazing. Range management based on soil survey information and other rangeland inventory information is the basis for maintaining or improving forage production.

woodland, windbreaks, and environmental plantings

This section was prepared by Elmer R. Umland, forester, Soil Conservation Service.

Dunn County has approximately 37,000 acres of native woodland. The principal areas are the Killdeer Mountains; the Badlands; the flood plains of Crooked Creek and of the Little Missouri, Green, and Knife Rivers; and wooded draws and small drainageways. The Killdeer Mountains have about 7,000 acres of woodland. Quaking aspen is the dominant tree; however, there are minor amounts of green ash, paper birch, boxelder, American elm, bur oak, various species of willow, common chokecherry, silver buffaloberry, and hazel. These trees and shrubs are growing on the Lakoa, Arnegard, and Parshall soils.

The Badlands area has about 16,000 acres of woodland. Bur oak, American elm, green ash, and Rocky Mountain juniper are the dominant species. The Badlands also has minor amounts of quaking aspen, common chokecherry, silver buffaloberry, and American plum. These trees and shrubs are growing on the Arikara, Arnegard, Parshall, and Cherry soils.

The Little Missouri River flood plain has about 4,000 acres of woodland. Plains cottonwood, green ash, ano various species of willow are the dominant species. Small amounts of common chokecherry, juneberry, and currant are also on the flood plain. These species are growing on the Banks and Havrelon soils and the Trembles Variant.

The Green and Knife River Valleys, Crooked Creek Valley, and the wooded draws have about 10,000 acres of woodland. Green ash and bur oak are the dominant species. Minor species are American elm, silver buffaloberry, common chokecherry, and various species of hawthorne. These species are growing on the Straw soils.

Early settlers used the trees for fuel, lumber, and fence posts. Today, these woodland species are not used much for these purposes.

Windbreaks have been planted in Dunn County since the days of the first settlers. Most of the early plantings were in the form of farmstead and feedlot protection. Approximately 200 acres of trees and shrubs were planted in the county under the United States Department of Agriculture, Forest Service's Prairie States and Forestry Project of the late 1930's. Since that time, nearly 3,000,000 trees and shrubs have been planted on over 4,300 acres by county farmers assisted by the Soil Conservation Service and the Dunn County Soil Conservation District. Tree plantings are still needed around numerous farmsteads; however, the major need is for windbreaks in cultivated areas where the hazard of soil blowing is serious.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife (fig. 14).

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To insure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 7 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 7 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a nursery.

recreation

This section was prepared by Erling Podoll, biologist, Soil Conservation Service.

Dunn county has 19 recreation areas. Six are a part of the impoundment of the Missouri River, and one is a national wildlife refuge. There are about 12 private and municipal areas. Four developed areas are available for public use at Lake Sakakawea; one is part of Lake Ilo National Wildlife Refuge; and two are municipal picnic-play areas.

Undeveloped areas available for extensive public use include 12,000 acres of Corps of Engineers lands adjacent to Lake Sakakawea, 16,000 acres of land administered by the Bureau of Land Management, and a 6,700 acre game management area. They are usually available for such activities as hiking, hunting, nature study, bird watching, and photography.

The Little Missouri River has been declared a scenic river by the North Dakota Legislature.

The soils of the survey area are rated in table 8 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water

Figure 14.—The Wabek soils, foreground, are protected from erosion by a cover of native plants. The long, smooth-sloping soils, background, are protected from water erosion by contour stripcropping and from soil blowing by field windbreaks.

impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 8, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 8 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 11 and interpretations for dwellings without basements and for local roads and streets in table 10.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or

stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Paths and trails for hiking, horseback riding, and bicycling should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

wildlife habitat

This section was prepared by Erling Podoll, biologist, Soil Conservation Service.

Wildlife resources have been and continue to be a very important part of the history, the life style, and recreation for Dunn County residents. Fisheries have gained importance in the last few decades. They have stimulated business and local economy and have contributed greatly to the social well-being of citizens as well as visitors.

Wildlife numbers are substantially lower than in presettlement time. Species numbers have held up well as has variety of habitat.

Mammals of greatest importance in the county are white-tailed deer, mule deer, pronghorn, red fox, coyote, bobcat, mink, raccoon, and jack rabbit. Former resident mammals include elk, bison, black bear, cougar, and river otter. Former residents, now extinct, include Plains grizzly bear, Audubon bighorn sheep, and prairie gray wolf. Former resident mammals on the endangered species list are the black-footed ferret and northern kit fox.

Bird species and numbers have recovered well after the early decades of settlement. Farm game species, the ring-necked pheasant and gray partridge, have been introduced and are well adapted to the Dunn County environment. The other major game bird species is the sharp-tailed grouse. Game birds of lesser importance in the county are ducks, geese, and mourning dove. Nongame species are quite numerous because Dunn County has diversified habitat. Former resident bird species are the raven and bald eagle. The Canada goose, once a resident, is now making a comeback. Two former resident birds, the American penegrine falcon and the bald eagle, are on the endangered species list. Limited numbers of wild turkey inhabit areas of the Killdeer Mountains and flood plains along streams.

About 15 percent of the county residents hunt and fish. Public fishing is limited to Lake Sakakawea, Little Missouri River, Knife River, and Lake Ilo. In addition, a few private water developments are managed for sport fisheries. There is good potential for construction of additional reservoirs in the survey area for sport fishing.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 9, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, bromegrass, sweetclover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestem, goldenrod, beggarweed, wheatgrass, and grama.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are common chokecherry, silver buffaloberry, snowberry, and silver sagebrush.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, saltgrass, cordgrass, bulrushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include gray partridge, pheasant, meadowlark, field sparrow, cottontail, and red fox.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include antelope, deer, sharptail grouse, meadowlark, and lark bunting.

engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

building site development

Table 10 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock or a very firm dense layer, stone content, soil texture, and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

sanitary facilities

Table 11 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 11 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and that overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to effectively filter the effluent. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 11 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 11 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

construction materials

Table 12 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a probable or improbable source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction.

Specifications for each use vary widely. In table 12, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

water management

Table 13 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, or to other layers that affect the rate of water movement, permeability, depth to a high water table or depth of standing water if the soil is subject to ponding, slope, susceptibility to flooding, subsidence of organic layers, and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or

sulfur. Availability of drainage outlets is not considered.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, toxic substances, such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

soil properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 17.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

engineering index properties

Table 14 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil series and their morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains particles coarser than sand, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (*1*).

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as Pt. Soils exhibiting engineering properties of two groups can have a dual classification, for example, SP-SM.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The AASHTO classification for soils tested, with group index numbers in parentheses, is given in table 17.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

physical and chemical properties

Table 15 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can

be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to wind erosion.

soil and water features

Table 16 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt and water in swamps and marshes are not considered flooding.

Table 16 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, common, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *common* that it is likely under normal conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered is local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 16 are the depth to the seasonal high water table; the kind of water table—that is, perched, artesian, or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 16.

An apparent water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. An artesian water table is under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole. A perched water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is specified as either soft or hard. If the rock is soft or fractured, excavations generally can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavations.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured clayey soils that have a high water table in winter are most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low, moderate,* or *high,* is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

engineering index test data

Table 17 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are typical of the series and are described in the section "Soil series and their morphology." The soil samples were tested by the North Dakota State Highway Department Laboratory. .

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are: AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); and Moisture density, Method A—T 99 (AASHTO), D 698 (ASTM).

classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (*8*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. In table 18, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Boroll (*Bor*, meaning cool, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haploborolls (*Hapl*, meaning minimal horizonation, plus *boroll*, the suborder of the Mollisols that have a mean annual soil temperature of less than 47 degrees).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Haploborolls.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed Typic Haploborolls.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

soil series and their morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (*7*). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (*8*). Unless otherwise stated, matrix colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed soil map units."

Amor series

The Amor series consists of moderately deep, well drained soils that are moderately permeable. These soils are on uplands. They formed in residuum weathered from stratified, soft sandstone and siltstone. Slope ranges from 1 to 15 percent.

Amor soils are similar to Morton and Shambo soils and are commonly adjacent to Arnegard, Morton, Sen, Shambo, and Vebar soils. Morton and Sen soils have less sand than the Amor soils and are in similar positions on the landscape. Arnegard soils have a mollic epipedon

more than 16 inches thick and are in concave swales. Shambo soils do not have the soft bedrock within a depth of 40 inches that the Amor soils have. They are on terraces and fans. Vebar soils have more sand than Amor soils and are on adjacent uplands.

Typical pedon of Amor loam, 3 to 6 percent slopes, 210 feet west and 140 feet north of the southeast corner of sec. 11, T. 144 N., R. 94 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, friable, slightly sticky and slightly plastic; common very fine roots; about 1 percent pebbles; slightly acid; abrupt smooth boundary.

B21—7 to 13 inches; dark brown (10YR 4/3) very fine sandy loam, dark brown (10YR 3/3) moist; weak coarse prismatic structure parting to weak medium subangular blocky; soft, friable, slightly sticky and slightly plastic; common very fine roots; about 1 percent pebbles; neutral; gradual wavy boundary.

B22—13 to 21 inches; brown (10YR 5/3) very fine sandy loam, dark brown (10YR 4/3) moist; moderate coarse prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; about 1 percent pebbles; neutral; gradual wavy boundary.

C—21 to 34 inches; light brownish gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; common medium distinct yellowish brown (10YR 5/6) weathered coarse fragments; weak medium subangular blocky structure; hard, friable, sticky and plastic; common very fine roots; about 1 percent pebbles; weathered band of yellowish brown (10YR 5/6) silty clay loam, 0 to 4 inches thick; mildly alkaline; clear wavy boundary.

Cr—34 to 60 inches; light brownish gray (2.5Y 6/2) finely stratified soft siltstone, grayish brown (2.5Y 5/2) moist; few very fine roots; common medium irregularly shaped soft masses of carbonates; violent effervescence; moderately alkaline.

Soft siltstone or sandstone typically is at a depth of 30 to 40 inches but ranges from a depth of 20 to 40 inches. Carbonates are at a depth of 10 to 35 inches.

The A horizon has color value of 4 or 5 and chroma of 2 or 3. Value is 2 or 3 if the soil is moist. The A horizon is as much as 15 percent pebbles or stone fragments. The B2 horizon has hue of 10YR or 2.5Y and chroma of 2 or 3. It is very fine sandy loam or loam. The C horizon has color value of 6 or 7 and chroma of 2 or 3. It has a value of 4 through 6 if the soil is moist. The Cr horizon is stratified, soft, fine grained sandstone, siltstone, or shale.

Arikara series

The Arikara series consists of deep, well drained soils that are moderately permeable. These soils are on uplands. They formed in colluvium. Slope ranges from 9 to 75 percent.

Arikara soils are similar to Cherry and Lakoa soils and commonly adjacent to Cabba and Cherry soils on the landscape. Cherry soils have a surface layer of silty clay loam. They are on lower fans and terraces. Lakoa soils have an A2 horizon and an argillic horizon. Cabba soils are shallow and are on steep ridgetops.

Typical pedon of Arikara loam, 9 to 75 percent slopes, 1,000 feet east and 2,000 feet north of the southwest corner of sec. 11, T. 148 N., R. 96 W.

01—1 inch to 0; woodland litter and partially decomposed litter; abrupt smooth boundary.

A1—0 to 1 inch; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; few coarse, many fine and medium roots; slightly acid; abrupt wavy boundary.

B21—1 inch to 6 inches; grayish brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky and plastic; common fine and medium roots; neutral; abrupt smooth boundary.

B22—6 to 13 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure parting to weak medium and fine subangular blocky; hard, friable, sticky and plastic; common fine and medium roots; neutral; abrupt smooth boundary.

C1ca—13 to 38 inches; light brownish gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; few fine and medium roots; common soft masses of carbonates; strong effervescence; mildly alkaline; gradual wavy boundary.

C2—38 to 53 inches; light yellowish brown (2.5Y 6/4) loam, olive brown (2.5Y 4/4) moist; massive; soft, very friable, slightly sticky and slightly plastic; slight effervescence; mildly alkaline; gradual wavy boundary.

C3—53 to 60 inches; light yellowish brown (2.5Y 6/4) fine sandy loam, olive brown (2.5Y 4/4) moist; massive; loose, nonsticky and nonplastic; slight effervescence; mildly alkaline.

The thickness of the solum and depth to carbonates ranges from 11 to 28 inches.

The A horizon has color value of 2 through 4 and chroma of 1 or 2. Value is 2 or 3 if the soil is moist. The A horizon is loam or clay loam. The B horizon has hue of 2.5Y or 10YR, value of 5 or 6, and chroma of 2 through

4. It has value of 4 or 5 if the soil is moist. It typically is loam or clay loam, but in some pedons it is silt loam or silty clay loam. Some pedons have a B3ca horizon. The C horizon has hue of 2.5Y or 5Y, value of 5 through 7, and chroma of 1 through 4. It has value of 4 or 5 if the soil is moist. It is loam, fine sandy loam, clay loam, or silt loam. In places stratified layers range from fine sandy loam to silty clay. Some pedons do not have a Cca horizon.

Arnegard series

The Arnegard series consists of deep, well drained soils that are moderately permeable. These soils are on uplands. They formed in mixed, loamy alluvium. Slope ranges from 1 to 6 percent.

Arnegard soils are similar to Grail, Parshall, Shambo, and Straw soils and are commonly adjacent to Amor, Farland, Grail, Morton, Parshall, Sen, Shambo, and Williams soils on the landscape. Grail and Parshall soils are in similar positions on the landscape. Grail soils are fine textured and have an argillic horizon. Parshall soils have more sand than Arnegard soils. The organic matter in Straw soils decreases irregularly with depth. They are on flood plains. Amor, Farland, Morton, Sen, Shambo, and Williams soils have a mollic epipedon less than 16 inches thick. They are on uplands.

Typical pedon of Arnegard loam, 3 to 6 percent slopes, 1,990 feet south and 430 feet east of the northwest corner of sec. 36, T. 144 N., R. 94 W.

A11—0 to 4 inches; very dark grayish brown (10YR 3/2) loam, very dark brown (10YR 2/2) moist; weak fine and medium granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; slightly acid; clear wavy boundary.

A12—4 to 10 inches; very dark grayish brown (10YR 3/2) loam, very dark brown (10YR 2/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; soft, very friable, slightly sticky and slightly plastic; many very fine and few medium roots; slightly acid; gradual wavy boundary.

B1—10 to 20 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and few medium roots; neutral; gradual wavy boundary.

B21—20 to 33 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate fine and medium prismatic structure parting to moderate fine and medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; neutral; gradual wavy boundary.

B22—33 to 42 inches; grayish brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; moderate fine prismatic structure parting to moderate fine subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; neutral; gradual wavy boundary.

C1—42 to 55 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; neutral; gradual wavy boundary.

C2—55 to 60 inches; light brownish gray (10YR 6/2) very fine sandy loam, grayish brown (10YR 5/2) moist; weak medium subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; few very fine roots; about 2 percent pebbles; neutral.

The solum ranges from 20 inches to more than 40 inches in thickness. The mollic epipedon is 18 to 34 inches thick. Carbonates range in depth from 35 inches to more than 60 inches.

The A horizon has color value of 3 or 4. Value is 2 or 3 if the soil is moist. The A horizon is loam or silt loam. The B horizon has chroma of 2 or 3. It is loam or silt loam. The C horizon has color value of 5 through 7 and chroma of 2 or 3. It has value of 4 or 5 if the soil is moist. It is loam, very fine sandy loam, or silt loam.

Baahish series

The Baahish series consists of deep, somewhat excessively drained soils that are shallow to very gravelly material. These soils are on uplands. They have moderate permeability in the solum and rapid permeability in the underlying gravelly material. These soils formed in thin, loamy alluvium over very gravelly outwash. Slope ranges from 9 to 60 percent.

Baahish soils are similar to Hidatsa and Wabek soils and are commonly adjacent to Cohagen, Hidatsa, and Vebar soils on the landscape. Hidatsa soils are on lower fans and terraces and have gravel at a depth of more than 20 inches. Wabek soils do not have a cambic horizon. Cohagen and Vebar soils have more sand and do not have the gravelly limestone that the Baahish soils have. Cohagen soils are on steep ridgetops. Vebar soils are on side slopes and foot slopes.

Typical pedon of Baahish fine sandy loam, 9 to 50 percent slopes, 980 feet west and 2,440 feet north of the southeast corner of sec. 12, T. 146 N., R. 96 W.

A1—0 to 3 inches; very dark grayish brown (10YR 3/2) fine sandy loam, very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; 5 percent limestone pebbles; neutral; clear smooth boundary.

B2—3 to 8 inches; dark grayish brown (10YR 4/2) sandy loam, very dark grayish brown (10YR 3/2) moist;

moderate medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; 5 percent limestone pebbles; neutral; abrupt smooth boundary.

B3ca—8 to 13 inches; brown (10YR 5/3) fine sandy loam, brown (10YR 4/3) moist; weak medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; few fine soft masses of carbonates; strong effervescence; 10 percent limestone pebbles; mildly alkaline; clear smooth boundary.

IIC1ca—13 to 28 inches; light gray (10YR 7/2) very gravelly fine sandy loam; brown (10YR 5/3) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; few fine soft masses of carbonates; strong effervescence; 60 percent limestone pebbles and cobbles; mildly alkaline; clear smooth boundary.

IIC2—28 to 47 inches; light gray (2.5Y 7/2) very gravelly fine sandy loam, light olive brown (2.5Y 5/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; few fine soft masses of lime; strong effervescence; 60 percent limestone pebbles and cobbles; mildly alkaline; clear smooth boundary.

IIC3—47 to 60 inches; light gray (2.5Y 7/2) and light yellowish brown (2.5Y 6/4) very gravelly loam, light olive brown (2.5Y 5/4) moist; massive; slightly hard, friable, sticky and plastic; few very fine roots; strong effervescence; 40 percent limestone pebbles and cobbles; mildly alkaline.

The thickness of the solum and depth to very gravelly material is from 7 to 15 inches. The mollic epipedon is 7 to 10 inches thick.

The A horizon has color value of 3 through 5 and chroma of 1 through 3. It has value of 2 or 3 if the soil is moist. It is fine sandy loam, loam, or silt loam. The B horizon has color value of 3 through 5 and chroma of 2 or 3. Value is 2 through 4 if the soil is moist. The B horizon is sandy loam, fine sandy loam, loam, or silt loam. The IIC horizon has color value of 5 through 8. Value is 4 through 7 if the soil is moist. The IIC horizon is very gravelly fine sandy loam, very gravelly sandy loam, or very gravelly loam. It averages 35 to 60 percent pebbles and 10 to 40 percent cobbles. Fine sand, sand, or clay is below a depth of 60 inches in some pedons.

Banks series

The Banks series consists of deep, somewhat excessively drained soils that are rapidly permeable. These soils are on flood plains and terraces. They formed in recently deposited sandy alluvium. Slope ranges from 1 to 3 percent.

Banks soils are commonly adjacent to Havrelon soils on the landscape. Havrelon soils have more silt and less clay than the Banks soils and are on the bottom lands. The Havrelon soils are more distant from the stream channels than the Banks soils.

Typical pedon of Banks loamy sand, 1 to 3 percent slopes, 400 feet west and 2,350 feet north of the southeast corner of sec. 6, T. 147 N., R. 97 W.

A1—0 to 4 inches; light brownish gray (2.5Y 6/2) loamy sand, dark grayish brown (2.5Y 4/2) moist; weak thick platy structure; soft, very friable, nonsticky and nonplastic; common fine roots; few fine stratifications of very fine sand and silt; strong effervescence; mildly alkaline; clear wavy boundary.

C1—4 to 9 inches; light brownish gray (2.5Y 6/2) fine sand, dark grayish brown (2.5Y 4/2) moist; single grain; loose, nonsticky and nonplastic; common fine roots; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—9 to 60 inches; light brownish gray (2.5Y 6/2) stratified fine sand and sand, dark grayish brown (2.5Y 4/2) moist; single grain; loose, nonsticky and nonplastic; common fine roots; strong effervescence; moderately alkaline.

The A horizon has color value of 5 through 7 and chroma of 1 through 3. It has value of 4 through 6 if the soil is moist. It typically is loamy sand, but in some pedons it is loamy fine sand, sandy loam, or fine sandy loam. The 10- to 40-inch control section is stratified loamy fine sand, fine sand, or sand.

Belfield series

The Belfield series consists of deep, well drained soils that are slowly permeable. These soils are on uplands. They formed in residuum and alluvium. Slope ranges from 1 to 6 percent.

Belfield soils are similar to Daglum and Rhoades soils and are commonly adjacent to Daglum, Farland, Grail, Morton, Regent, Rhoades, and Savage soils on the landscape. Daglum and Rhoades soils have a strong, columnar structure. Rhoades soils have a thin solum. Farland, Grail, Morton, Regent, and Savage soils do not have a natric horizon and are on uplands, fans, terraces, and foot slopes.

Typical pedon of Belfield silty clay loam in an area of Belfield-Grail silty clay loams, 1 to 3 percent slopes, 500 feet south and 2,240 feet west of the northeast corner of sec. 5, T. 145 N., R. 94 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, friable, sticky and plastic; neutral; abrupt smooth boundary.

A12—8 to 12 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium and coarse prismatic structure parting to weak medium subangular blocky;

slightly hard, firm, sticky and plastic; neutral; abrupt irregular boundary.

A&B—12 to 14 inches; grayish brown (10YR 5/2) silty clay loam (A2), very dark grayish brown (10YR 3/2) moist; dark grayish brown (10YR 4/2) silty clay (B2t), very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to moderate medium and fine angular blocky; slightly hard, friable, sticky and plastic; neutral; clear irregular boundary.

B2t—14 to 25 inches; dark grayish brown (10YR 4/2) silty clay, very dark grayish brown (10YR 3/2) moist; strong medium prismatic structure parting to strong medium and fine angular blocky; hard, very firm, very sticky and very plastic; thin continuous clay films; mildly alkaline; gradual wavy boundary.

B3csca—25 to 30 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure; hard, firm, sticky and plastic; fine masses of gypsum crystals; disseminated carbonates; few very fine salt crystals; strong effervescence; moderately alkaline; gradual wavy boundary.

C1saca—30 to 39 inches; mixed pale olive and white (5Y 6/3 and 8/1) silty clay loam, olive and light gray (5Y 5/3 and 7/1) moist; weak medium prismatic structure; very hard, firm, sticky and plastic; few very fine salt crystals; common medium soft masses of carbonates; violent effervescence; moderately alkaline; gradual wavy boundary.

C2—39 to 60 inches; mixed pale yellow and white (2.5Y 7/4 and 5Y 8/1) silty clay loam, light olive brown and gray (2.5Y 5/4 and 5Y 6/1) moist; massive; very hard, firm, sticky and plastic; violent effervescence; moderately alkaline.

Carbonates are at a depth of 20 to 35 inches. Soft shale or siltstone bedrock is at a depth of over 40 inches.

The A horizon typically is silty clay loam, but in some pedons it is silt loam. The B horizon has color value of 4 through 6 and chroma of 2 or 3. It has a value of 3 through 5 if the soil is moist. The C horizon has color value of 5 through 8 and chroma of 1 through 4. Value is 5 through 7 if the soil is moist. The C horizon is silty clay or silty clay loam.

Bowdle series

The Bowdle series consists of deep, well drained soils that are moderately deep over sand and gravel. These soils are on terraces. Permeability is moderate in the solum and rapid in the underlying sand and gravel. These soils formed in loamy alluvium over deposits of sand and gravel. Slope ranges from 1 to 6 percent.

Bowdle soils are similar to Hidatsa soils and are commonly adjacent to Arnegard, Shambo, Straw, and Williams soils on the landscape. Arnegard, Shambo, and Straw soils do not have sand and gravel within a depth of 40 inches as does the Bowdle soils. Hidatsa soils are underlain by limestone gravelly material. Williams soils formed in till on nearby uplands. Arnegard soils are in swales and shallow depressions. Hidatsa, Shambo, and Bowdle soils are in similar positions on the landscape. Straw soils are on bottom lands.

Typical pedon of Bowdle loam, 1 to 3 percent slopes, 1,100 feet west and 2,605 feet south of the northeast corner of sec. 25, T. 141 N., R. 97 W.

Ap—0 to 10 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; few roots; neutral; clear smooth boundary.

B21—10 to 18 inches; dark brown (10YR 4/3) loam, dark brown (10YR 3/3) moist; moderate medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; few roots; neutral; clear smooth boundary.

B22—18 to 29 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to moderate fine subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; few pebbles; few roots; neutral; gradual smooth boundary.

IIC—29 to 60 inches; dark brown (10YR 4/3) very gravelly sand, very dark grayish brown (10YR 3/2) moist; single grain; loose, nonsticky and nonplastic; about 50 percent pebbles; thin crusts of carbonates on the underside of pebbles; slight effervescence; mildly alkaline.

The thickness of the solum and the depth to carbonates ranges from 16 to 32 inches. Loose sand and gravel typically are at a depth of about 29 inches but range in depth from 20 to 40 inches. The mollic epipedon is 16 to 32 inches thick and includes the B2 horizon. Some pedons have a Cca horizon above the underlying sand and gravel.

The A horizon has color value of 3 or 4 or 2 or 3 if the soil is moist. It typically is loam, but in some pedons it is silt loam. The B2 horizon has hue of 10YR or 2.5Y and value of 3 through 5. Value is 2 or 3 if the soil is moist.

Brandenburg series

The Brandenburg series consists of deep, excessively drained soils that are shallow to shattered porcelanite beds. These soils are on uplands. They formed in residuum from porcelanite. Permeability is moderate in the upper layers and very rapid in the underlying porcelanite. Slope ranges from 6 to 50 percent.

Brandenburg soils are similar to and commonly adjacent to Cabba, Rhoades, and Searing soils on the landscape. Cabba soils are underlain by soft bedrock.

Rhoades soils have strong, columnar structure. Searing soils have a mollic epipedon and are underlain by shattered porcelanite at a depth of 20 to 40 inches. These soils are on nearby slopes or hills.

Typical pedon of Brandenburg loam in an area of Brandenburg-Cabba loams, 6 to 50 percent slopes, 110 feet south and 1,000 feet west of the northeast corner of sec. 31, T. 145 N., R. 93 W.

A1—0 to 6 inches; brown (7.5YR 5/4) loam, dark brown (7.5YR 4/4) moist; moderate coarse prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; 10 percent porcelanite chips; many fine and coarse roots; neutral; clear wavy boundary.

C1—6 to 10 inches; light red (2.5YR 6/8) very channery loam, red (2.5YR 4/8) moist; hard, very firm, nonsticky and nonplastic; few fragments; many fine roots; neutral; gradual wavy boundary.

C2—10 to 60 inches; light red (2.5YR 6/8) shattered porcelanite, red (2.5YR 4/8) moist; few fine and coarse roots; carbonate coatings on side and bottom surfaces of fragments; violent effervescence; moderately alkaline.

The surface layer is 2 to 6 inches thick. Porcelanite ranges in depth from 10 to 20 inches.

The A horizon has hue of 7.5YR or 5YR, value of 5 or 6, and chroma of 2 or more. Value is 4 or 5 if the soil is moist. The A horizon typically is loam, but in some pedons it is gravelly loam or channery loam.

Cabba series

The Cabba series consists of shallow, well drained soils that are moderately permeable. These soils are on uplands. They formed in residuum weathered from siltstone. Slope ranges from 3 to 70 percent.

Cabba soils are similar to Cohagen, Wayden, and Zahl soils and are commonly adjacent to Amor, Chama, Morton, and Rhoades soils on the landscape. Cohagen soils have more sand than Cabba soils. Wayden soils are fine textured. Zahl soils formed in till and are deep. Cohagen, Wayden, Zahl, and Cabba soils are in similar positions on the landscape. Amor, Chama, Morton, and Rhoades soils do not have bedrock within a depth of 20 inches. Amor, Chama, Morton, and Rhoades soils are on nearby side slopes and foot slopes. Rhoades soils have a dense, sodic subsoil.

Typical pedon of Cabba loam, 15 to 45 percent slopes, 130 feet south and 390 feet west of the northeast corner of sec. 36, T. 145 N., R. 93 W.

A1—0 to 3 inches; grayish brown (2.5Y 5/2) loam, very dark grayish brown (2.5Y 3/2) moist; weak medium prismatic structure; soft, friable, slightly sticky and slightly plastic; many fine roots; neutral; gradual wavy boundary.

AC—3 to 8 inches; light brownish gray (2.5Y 6/2) silt loam, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; many fine soft masses of carbonates; violent effervescence; mildly alkaline; gradual wavy boundary.

C—8 to 18 inches; grayish brown (2.5Y 5/2) silt loam, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure parting to weak fine angular blocky; slightly hard, friable, slightly sticky and slightly plastic; few very fine roots; many fine soft masses of carbonates; violent effervescence; mildly alkaline; gradual wavy boundary.

Cr1—18 to 40 inches; light gray (2.5Y 7/2) soft platy siltstone, light brownish gray (2.5Y 6/2) moist; few very fine roots; few medium soft masses of carbonates; strong effervescence; moderately alkaline; clear wavy boundary.

Cr2—40 to 60 inches; pale yellow (2.5Y 7/4) soft siltstone, light olive brown (2.5Y 5/4) moist; few fine soft masses of carbonates; slight effervescence; moderately alkaline.

The surface soil is 3 to 5 inches thick. Carbonates range from the surface to a depth of 5 inches. Soft, sedimentary beds are at a depth of 10 to 20 inches.

The A horizon has hue of 10YR or 2.5Y and value of 5 or 6. Value is 3 or 4 if the soil is moist. The A horizon typically is loam, but in some pedons it is very fine sandy loam or silt loam. The C horizon has hue of 10YR or 2.5Y, value of 5 through 8, and chroma of 2 through 4. It has value of 4 through 7 if the soil is moist. It typically is silt loam, but in some pedons it is loam.

Chama series

The Chama series consists of moderately deep, well drained soils that are moderately permeable. These soils are on uplands. They formed in materials weathered from soft siltstone. Slope ranges from 6 to 9 percent.

Chama soils are similar to and commonly adjacent to Cabba and Sen soils on the landscape. Cabba soils are less than 20 inches deep to soft bedrock and are on ridgetops and hill crests. Sen soils do not have carbonates in the upper 10 inches. They are in similar positions on the landscape.

Typical pedon of Chama silt loam in an area of Cabba-Chama silt loams, 6 to 9 percent slopes, 2,465 feet west and 290 feet south of the northeast corner of sec. 7, T. 142 N., R. 94 W.

Ap—0 to 7 inches; dark grayish brown (2.5Y 4/2) silt loam, very dark grayish brown (2.5Y 3/2) moist; moderate fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; neutral; abrupt smooth boundary.

A12—7 to 8 inches; dark grayish brown (2.5Y 4/2) silt loam, very dark grayish brown (2.5Y 3/2) moist; moderate coarse prismatic structure; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; neutral; clear wavy boundary.
B2—8 to 12 inches; grayish brown (2.5Y 5/2) silt loam, dark grayish brown (2.5Y 4/2) moist; moderate coarse prismatic structure; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; few fine threads of carbonates; strong effervescence; mildly alkaline; gradual wavy boundary.
C1ca—12 to 21 inches; light brownish gray (2.5Y 6/2) silt loam, dark grayish brown (2.5Y 4/2) moist; moderate coarse prismatic structure; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; few fine masses of carbonates; violent effervescence; moderately alkaline; clear wavy boundary.
C2ca—21 to 30 inches; light gray (2.5Y 7/2) silt loam, light brownish gray (2.5Y 6/2) moist; moderate coarse prismatic structure; slightly hard, very friable, slightly sticky and slightly plastic; few fine masses of carbonates; violent effervescence; moderately alkaline; clear wavy boundary.
Cr—30 to 60 inches; light gray (10YR 7/2) soft laminated siltstone, light olive gray (5Y 6/2) moist; slight effervescence; moderately alkaline.

Carbonates range from the surface to a depth of 10 inches. Soft sedimentary bedrock is at a depth of 20 to 40 inches.

The A horizon has hue of 10YR or 2.5Y and value of 4 or 5. It has value of 2 or 3 if the soil is moist. The A horizon typically is silt loam, but in some pedons it is loam. The B horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 2 or 3. Value is 3 or 4 if the soil is moist. The Cca horizon has hue of 10YR or 2.5Y, value of 6 or 7, and chroma of 1 or 2. It has value of 4 through 6 if the soil is moist. The soft, sedimentary beds are siltstone, shale, and sandstone. Some pedons do not have thin layers of coal or coal slag.

Cherry series

The Cherry series consists of deep, well drained soils that are moderately slowly permeable. These soils are on uplands. They formed in recent alluvium. Slope ranges from 1 to 15 percent.

Cherry soils are similar to Farland, Savage, and Shambo soils and are commonly adjacent to Cabba, Havrelon, and Vanda soils on the landscape. Farland, Savage, and Shambo soils have a mollic epipedon and formed in alluvium on terraces and uplands. In addition, Farland and Savage soils have an argillic horizon. Savage soils are fine textured, and Shambo soils have more sand than Cherry soils. Cabba soils have soft bedrock within a depth of 20 inches and are on hilltops and ridge crests. Havrelon soils also have more sand than Cherry soils but are on lower fans and flood plains. Vanda soils are strongly alkaline, have a surface layer of silty clay, and formed in clayey alluvium. Vanda soils are on fans and terraces.

Typical pedon of Cherry silty clay loam in an area of Cherry-Cabba complex, 9 to 25 percent slopes, 1,680 feet west and 500 feet north of the southeast corner of sec. 22, T. 148 N., R. 95 W.

A1—0 to 4 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; many fine and medium roots; few fine round soft masses of carbonates; slight effervescence; mildly alkaline; clear wavy boundary.
B21—4 to 11 inches; light brownish gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky and plastic; common fine roots; strong effervescence; moderately alkaline; gradual wavy boundary.
B22—11 to 26 inches; light brownish gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) moist; moderate medium prismatic structure parting to weak medium platy; hard, friable, sticky and plastic; few fine roots; common fine irregularly disseminated soft masses of carbonates; strong effervescence; moderately alkaline; gradual wavy boundary.
C1—26 to 48 inches; light brownish gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; moderate medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; violent effervescence; moderately alkaline; abrupt wavy boundary.
C2—48 to 60 inches; light brownish gray (2.5Y 6/2) stratified silty clay, silty clay loam, and silt loam, grayish brown (2.5Y 5/2) moist; massive; hard, friable, slightly sticky and slightly plastic; few fine round soft masses of carbonates; strong effervescence; moderately alkaline.

The A1 horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 2 or 3. It has value of 3 or 4 if the soil is moist. It typically is silty clay loam, but in some pedons it is silt loam, loam, or clay loam. The B horizon has hue of 10YR or 2.5Y, value of 5 through 7, and chroma of 2 through 4. Value is 4 through 6 if the soil is moist. The B horizon is silty clay loam or silt loam. The C horizon has hue of 2.5Y or 5Y, value of 5 through 7, and chroma of 2 through 4. It has value of 4 through 6 if the soil is moist.

Cohagen series

The Cohagen series consists of shallow, somewhat excessively drained soils that are moderately rapidly

permeable. These soils are on uplands. They formed in moderately coarse material weathered from soft sandstone. Slope ranges from 9 to 40 percent.

Cohagen soils are similar to Cabba soils and are commonly adjacent to Parshall and Vebar soils on the landscape. Cabba soils have more silt and less sand than Cohagen soils. Cabba and Cohagen soils are in similar positions on the landscape. Parshall and Vebar soils have a mollic epipedon and are on side slopes and foot slopes.

Typical pedon of Cohagen fine sandy loam in an area of Cohagen-Vebar fine sandy loams, 9 to 25 percent slopes, in native grass, 1,500 feet south and 230 feet west of the northeast corner of sec. 22, T. 148 N., R. 93 W.

A1—0 to 4 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; weak fine subangular blocky structure parting to weak fine granular; soft, very friable, nonsticky and nonplastic; many roots; mildly alkaline; clear wavy boundary.

C—4 to 15 inches; light olive brown (2.5Y 5/4) fine sandy loam, olive brown (2.5Y 4/4) moist; weak medium and fine subangular blocky structure; soft, very friable, nonsticky and nonplastic; common roots; slight effervescence; mildly alkaline; gradual wavy boundary.

Cr—15 to 60 inches; light brownish gray (2.5Y 6/2) soft calcareous sandstone, olive brown (2.5Y 4/4) moist; few fine roots; slight effervescence; mildly alkaline.

Soft sandstone ranges in depth from 10 to 20 inches.

The A horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 2 or 3. It has value of 3 or 4 if the soil is moist. It is fine sandy loam or sandy loam. The C horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 2 through 4. Value is 4 or 5 if the soil is moist. The C horizon is fine sandy loam or sandy loam. Ledges of hard sandstone are frequently in the bedrock.

Colvin series

The Colvin series consists of deep, poorly drained soils that are moderately slowly permeable. These saline soils are on uplands. They formed in silt loam and silty clay loam alluvial sediments. Slope is 0 to 1 percent.

Colvin soils are commonly adjacent to Belfield, Rhoades, Parshall, and Vebar soils on the landscape. Belfield and Rhoades soils have a natric horizon and are on uplands and terraces. Parshall and Vebar soils have more sand than Colvin soils. Parshall soils are on fans, swales, and foot slopes. Vebar soils are on plane and convex slopes of uplands.

Typical pedon of Colvin silt loam, saline, 2,140 feet west and 600 feet north of the southeast corner of sec. 12, T. 145 N., R. 92 W.

A1—0 to 14 inches; dark gray (10YR 4/1) silt loam, very dark gray (10YR 3/1) moist; weak very coarse prismatic structure parting to moderate fine granular; soft, very friable, slightly sticky and slightly plastic; common very fine roots; few fine generally rounded soft masses of carbonates; krotovinas and old root channels filled with material from the C horizon; violent effervescence; mildly alkaline; gradual irregular boundary.

C1ca—14 to 24 inches; grayish brown (2.5Y 5/2) silt loam, very dark grayish brown (2.5Y 3/2) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; common fine generally rounded soft masses of carbonates; violent effervescence; moderately alkaline; gradual irregular boundary.

C2cacs—24 to 34 inches; light brownish gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; massive; hard, friable, sticky and plastic; many fine generally rounded masses and few large filaments of carbonates; common fine salt crystals; violent effervescence; moderately alkaline; gradual smooth boundary.

C3ca—34 to 50 inches; light olive gray (5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; few fine gray (N 6/0) mottles; massive; very hard, firm, sticky and plastic; common large irregular masses and many fine and medium filaments of carbonates; few fine salt crystals; violent effervescence; moderately alkaline; gradual smooth boundary.

IIC4—50 to 60 inches; gray (5Y 7/2) stratified sand, silt, and clay, dark grayish brown (2.5Y 4/2) moist; common medium and fine distinct gray (N 6/0) mottles; extremely hard, firm, slightly sticky and slightly plastic; common fine salt crystals; violent effervescence; moderately alkaline.

The mollic epipedon is 7 to 24 inches thick.

The A1 horizon has hue of 10YR, 2.5Y, or 5Y and value of 4. Value is 2 or 3 if the soil is moist. The C horizon typically is silt loam, but in some pedons it is silty clay loam. The Cca horizon has color value of 5 through 8. Value is 3 through 5 if the soil is moist. The C horizon has hue of 2.5Y or 5Y, value of 5 through 7, and chroma of 2 through 4. It has value of 3 through 5 if the soil is moist. Mottles range from few to many and faint to prominent. The C horizon is stratified sand, silt, and clay, but in some pedons it is silty clay loam and is not stratified.

Daglum series

The Daglum series consists of deep, moderately well drained soils that are very slowly permeable. These soils are on uplands. They formed in silty and clayey alluvium. Slope ranges from 1 to 6 percent.

Daglum soils are similar to Ekalaka and Rhoades soils and are commonly adjacent to Belfield, Farland, Morton,

Regent, Rhoades, and Savage soils on the landscape. Ekalaka soils have more sand than Daglum soils, Rhoades soils have a thinner surface horizon, and Belfield soils do not have the strong columnar structure. Farland, Morton, Regent, and Savage soils do not have a natric horizon. All of these soils and the Daglum soils are in similar positions on the landscape.

Typical pedon of Daglum silt loam, 1 to 6 percent slopes, 690 feet west and 1,770 feet south of the northeast corner of sec. 12, T. 144 N., R. 95 W.

A1—0 to 4 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure parting to weak thin platy; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; slightly acid; clear wavy boundary.

A2—4 to 7 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium platy structure; hard, friable, slightly sticky and slightly plastic; common very fine roots; slightly acid; abrupt wavy boundary.

B21t—7 to 13 inches; dark grayish brown (10YR 4/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; strong medium columnar structure parting to strong medium angular blocky; very hard, very firm, sticky and plastic; common very fine roots; many thin clay films on faces of peds; light brownish gray (10YR 6/2) clean silt grains on tops of columns; mildly alkaline; clear wavy boundary.

B22t—13 to 18 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; moderate medium subangular blocky structure; extremely hard, firm, sticky and plastic; few very fine roots; many thin clay films on faces of peds; strong effervescence; moderately alkaline; clear wavy boundary.

C1cs—18 to 27 inches; light brownish gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; moderate medium subangular blocky structure; extremely hard, firm, sticky and plastic; few very fine roots; many medium irregularly shaped masses of carbonates and nests of gypsum crystals; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—27 to 39 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium subangular blocky structure; extremely hard, friable, sticky and plastic; few fine irregularly shaped soft masses of carbonates; slight effervescence; moderately alkaline; clear wavy boundary.

IIC3—39 to 46 inches; light brownish gray (2.5Y 6/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak medium subangular blocky structure; very hard, friable, sticky and plastic; few fine irregularly shaped soft masses of carbonates and salt crystals; strong effervescence; moderately alkaline; clear wavy boundary.

IICr—46 to 60 inches; light gray (2.5Y 7/2) soft shale, light brownish gray (2.5Y 6/2) moist; many fine soft masses of carbonates and salt crystals; moderately alkaline.

The solum ranges from 14 to 24 inches in thickness. Visible salts are at a depth of more than 16 inches. The B horizon is at a depth of 5 to 15 inches. Soft shale is at a depth of more than 40 inches.

The A1 horizon has color value of 4 or 5. Value is 2 or 3 if the soil is moist. The A1 horizon typically is silt loam or silty clay loam, but in some pedons it is fine sandy loam or clay loam. The A2 horizon has hue of 10YR or 2.5Y, value of 5 through 7, and chroma of 1 or 2. Value is 3 through 5 if the soil is moist. The B2t horizon has color value of 4 through 6 and chroma of 2 or 3. It has value of 3 through 5 if the soil is moist. It is silty clay loam, silty clay, or clay. The C horizon has hue of 2.5Y or 5Y, value of 5 through 7, and chroma of 2 through 4. It has value of 3 through 6 if moist. It is clay loam, silty clay loam, silty clay, or stratified silt and clay.

Dimmick series

The Dimmick series consists of deep, very poorly drained soils that are very slowly permeable. These soils are on uplands. They formed in clayey sediments. Slope is 0 to 1 percent.

Dimmick soils are similar to Heil and Tonka soils and are commonly adjacent to Farland, Heil, and Williams soils on the landscape. Heil and Tonka soils are poorly drained and do not have a gleyed surface horizon. The Heil and Tonka soils and the Dimmick soils are in similar positions on the landscape. Farland and Williams soils are well drained. Farland soils are on nearby terraces. Williams soils are on nearby till uplands.

Typical pedon of Dimmick clay, 1,050 feet south and 180 feet east of the northwest corner of sec. 11, T. 144 N., R. 95 W.

01—3 inches to 0; roots and partly decomposed stems and leaves of plants; loose; abrupt smooth boundary.

A11g—0 to 3 inches; gray (10YR 5/1) clay, very dark gray (10YR 3/1) moist; many very fine distinct dark yellowish brown (10YR 4/4 moist) mottles; strong fine and very fine angular blocky structure; hard, firm, very sticky and very plastic; many fine and medium roots; neutral; gradual wavy boundary.

A12g—3 to 20 inches; gray (5Y 5/1) clay, very dark gray (5Y 3/1) moist; many medium distinct dark yellowish brown (10YR 4/4 moist) mottles; weak fine angular blocky structure; hard, very firm, very sticky and very plastic; common fine and few medium roots; neutral; gradual smooth boundary.

C1g—20 to 40 inches; gray (5Y 6/1) clay, dark gray (5Y 4/1) moist; many medium distinct olive brown (2.5Y 4/4 moist) mottles; weak fine subangular blocky structure; hard, very firm, very sticky and very plastic; few roots; neutral; diffuse wavy boundary.

C2g—40 to 60 inches; gray (N 6/0) clay, dark gray (N 4/0) moist; many coarse distinct olive brown (2.5Y 4/4 moist) mottles; massive; hard, very firm, very sticky and very plastic; mildly alkaline.

Depth to free carbonates is more than 25 inches and is commonly more than 40 inches.

The A horizon has hue of 10YR, 2.5Y, or 5Y; value of 4 or 5; and chroma of 1 or 2. It has value of 2 to 3 if the soil is moist. It is clay or silty clay. The C horizon has hue of 5Y, 2.5Y, or neutral; value of 5 through 7; and chroma of 2 or less. Value is 4 or 5 if the soil is moist. The C horizon is clay or silty clay.

Ekalaka series

The Ekalaka series consists of deep, moderately well drained soils that are slowly permeable. These soils are on uplands. They formed in alluvium or residuum weathered from soft sandstone. Slope ranges from 1 to 6 percent.

Ekalaka soils are commonly adjacent to Daglum, Parshall, and Vebar soils on the landscape. Daglum soils are on nearby uplands and are fine textured. Parshall and Vebar soils do not have a natric horizon and are on nearby terraces, fans, and uplands.

Typical pedon of Ekalaka fine sandy loam, 1 to 6 percent slopes, 1,390 feet north and 150 feet east of the southwest corner of sec. 17, T. 146 N., R. 95 W.

Ap—0 to 7 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium and fine granular structure; slightly hard, very friable, nonsticky and nonplastic; few fine roots; neutral; clear smooth boundary.

A12—7 to 11 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium and fine subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; few fine roots; neutral; clear smooth boundary.

A2—11 to 13 inches; light gray (2.5Y 7/2) loamy fine sand, grayish brown (2.5Y 5/2) moist; weak thick platy structure; slightly hard, very friable, nonsticky and nonplastic; few fine roots; mildly alkaline; abrupt wavy boundary.

B2t—13 to 21 inches; light brownish gray (2.5Y 6/2) fine sandy loam, grayish brown (2.5Y 5/2) moist; common fine distinct yellowish brown (10YR 5/4) mottles; strong coarse columnar structure parting to strong medium subangular blocky; extremely hard, very firm, slightly sticky and slightly plastic; few fine roots; slight effervescence; mildly alkaline; clear wavy boundary.

C1cs—21 to 38 inches; mottled light brownish gray (2.5Y 6/2), yellowish brown (10YR 5/4), and strong brown (7.5YR 5/6) fine sandy loam, mottled grayish brown (2.5Y 5/2), dark yellowish brown (10YR 4/4) and dark brown (7.5YR 4/4) moist; weak coarse and medium subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; many fine masses of segregated carbonates; few medium distinct white masses of salt crystals; strong effervescence; moderately alkaline; gradual wavy boundary.

C2cs—38 to 60 inches; mottled light brownish gray (2.5Y 6/2), yellowish brown (10YR 5/4), and strong brown (7.5YR 5/6) fine sandy loam, mottled grayish brown (2.5Y 5/2), dark yellowish brown (10YR 4/4), and dark brown (7.5YR 4/4) moist; weak coarse and medium subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; few fine masses of segregated carbonates and salt crystals; slight effervescence; moderately alkaline.

The solum ranges from 16 to 40 inches in thickness. The thickness of the surface layer and the depth to the extremely hard B2t horizon ranges from 9 to 20 inches.

The A horizon has color value of 4 or 5. Value is 2 or 3 if the soil is moist. The A horizon typically is fine sandy loam, but in some pedons it is loamy fine sand or sandy loam. The A2 horizon has color value of 5 through 7 and chroma of 1 or 2. It has value of 3 through 5 if the soil is moist. It is loamy fine sand or fine sandy loam. The B2t horizon has color value of 5 or 6 and chroma of 2 through 4. Value is 3 through 5 if moist. The B2t horizon typically is fine sandy loam, but in some pedons it is sandy loam or loam. The C horizon has color value of 5 through 7 and chroma of 2 through 6. Value is 4 through 6 if the soil is moist.

Farland series

The Farland series consists of deep, well drained soils that are moderately permeable. These soils are on terraces. They formed in alluvium. Slope ranges from 1 to 6 percent.

Farland soils are similar to Morton and Savage soils and are commonly adjacent to Belfield, Bowdle, Grail, Morton, Regent, Savage, and Shambo soils on the landscape. Morton and Regent soils have bedrock within a depth of 20 to 40 inches. They are on nearby uplands. Savage soils are fine textured. Belfield soils have a natric horizon and are in slight depressions of terraces and fans and are in swales. Bowdle soils have gravel at a depth of 20 to 40 inches. Grail soils are pachic and are in nearby swales and depressions. Shambo soils do not have an argillic horizon. Bowdle, Savage, and Shambo soils are in similar positions on the landscape.

Typical pedon of Farland silt loam, 1 to 3 percent slopes, 1,530 feet north and 700 feet east of the southwest corner of sec. 5, T. 142 N., R. 94 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; few fine roots; neutral; abrupt smooth boundary.

B21t—8 to 12 inches; light olive brown (2.5Y 5/4) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure parting to strong medium subangular blocky; hard, friable, sticky and plastic; few fine roots; thin clay films on faces of peds; neutral; clear wavy boundary.

B22t—12 to 18 inches; light olive brown (2.5Y 5/4) silty clay loam, dark grayish brown (2.5Y 4/2) moist; moderate coarse prismatic structure parting to strong medium subangular blocky; hard, friable, slightly sticky and slightly plastic; few fine roots; thin clay films on faces of peds; neutral; gradual wavy boundary.

B3—18 to 24 inches; light olive brown (2.5Y 5/4) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure parting to moderate medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; strong effervescence; mildly alkaline; gradual wavy boundary.

C1ca—24 to 31 inches; light brownish gray (2.5Y 6/2) silty clay loam, grayish brown (2.5Y 5/2) moist; weak medium prismatic structure parting to moderate medium subangular blocky; hard, friable, sticky and plastic; few fine roots; disseminated carbonates throughout; violent effervescence; moderately alkaline; gradual wavy boundary.

C2—31 to 60 inches; grayish brown (2.5Y 5/2) silt loam, dark grayish brown (2.5Y 4/2) moist; weak coarse to fine subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; strong effervescence; moderately alkaline.

The solum is 12 to 36 inches thick. The mollic epipedon is 7 to 10 inches thick. Carbonates begin at a depth of 8 to 30 inches.

The A horizon has color value of 4 or 5 and chroma of 2 or 3. It has value of 2 or 3 if the soil is moist. It typically is silt loam, but in some pedons it is loam or light clay loam. The B2t horizon has hue of 10YR or 2.5Y, value of 4 through 6, and chroma of 2 through 4. Value is 3 or 4 if the soil is moist. The B2t horizon is silty clay loam or clay loam. The C horizon is loam, clay loam, silt loam, or silty clay loam in the upper part and stratified very fine sand to silty clay below a depth of 40 inches.

Flaxton series

The Flaxton series consists of deep, well drained soils on uplands. Permeability is moderately rapid in the upper part and moderately slow in the underlying till. These soils formed in eolian sediment that is over loam and clay loam till. Slope ranges from 1 to 9 percent.

Flaxton soils are similar to Arnegard, Parshall, and Williams soils and are commonly adjacent to Arnegard, Parshall, Noonan, Williams, and Zahl soils on the landscape. Arnegard and Parshall soils do not have an argillic horizon and are in nearby concave swales and depressions. Williams soils are finer textured in the upper part of the solum. Noonan soils have a natric horizon and have a thinner mollic epipedon than the Flaxton soils. Noonan and Williams soils are on nearby uplands. Zahl soils do not have a cambic B horizon and are on upper crests and ridges.

Typical pedon of Flaxton fine sandy loam in an area of Flaxton-Williams complex, 1 to 6 percent slopes, 925 feet west and 760 feet south of the northeast corner of sec. 28, T. 145 N., R. 92 W.

A1—0 to 12 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak coarse and medium prismatic structure parting to weak fine subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; neutral; gradual wavy boundary.

B1—12 to 22 inches; brown (10YR 5/3) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to weak coarse and medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; neutral; clear wavy boundary.

IIB2t—22 to 29 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate coarse prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; common fine roots; thin continuous clay films; few pebbles; mildly alkaline; clear wavy boundary.

IIB3ca—29 to 42 inches; light brownish gray (2.5Y 6/2) clay loam, olive brown (2.5Y 4/4) moist; moderate coarse and medium prismatic structure; hard, friable, sticky and plastic; common fine roots; few pebbles; common medium masses of carbonates; strong effervescence; moderately alkaline; gradual wavy boundary.

IICca—42 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, olive brown (2.5Y 4/4) moist; massive; hard, friable, sticky and plastic; few fine roots; few pebbles; few fine masses of carbonates; strong effervescence; moderately alkaline.

Till ranges in depth from 20 to 40 inches. Rock fragments are in the till. The amount of rock fragments ranges from few to common. A thin stone or pebble line

lies between eolian sediment and the till in some pedons.

The A horizon has color value of 3 through 5 and chroma of 2 or 3. Value is 2 or 3 if the soil is moist. The A horizon typically is fine sandy loam, but in some pedons it is light loam. The IIB2t has hue of 2.5Y or 10YR, value of 4 through 6, and chroma of 2 through 4. It has value of 3 through 5 if the soil is moist. It is loam or clay loam. The IICca horizon has hue of 2.5Y or 5Y, value of 5 or 6, and chroma of 2 through 4. Value is 4 or 5 if the soil is moist. Some pedons have sandstone or shale below a depth of 40 inches.

Grail series

The Grail series consists of deep, well drained soils that are slowly permeable. These soils are on uplands. They formed in local alluvium. Slope ranges from 1 to 6 percent.

Grail soils are similar to Arnegard soils and are commonly adjacent to Arnegard, Belfield, Farland, Morton, Regent, Savage, and Williams soils on the landscape. Arnegard soils have less clay than Grail soils and do not have an argillic horizon. Arnegard and Grail soils are in similar positions on the landscape. Belfield soils have a natric horizon. Farland, Morton, Regent, Savage, and Williams soils have a thinner mollic epipedon than Grail soils. Belfield, Farland, and Savage soils are on nearby fans and terraces. Morton, Regent, and Williams soils are on upland side slopes and foot slopes.

Typical pedon of Grail silt loam, 1 to 3 percent slopes, in wheat stubble, 1,760 feet east and 2,040 feet north of the southwest corner of sec. 35, T. 145 N., R. 94 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; neutral; abrupt smooth boundary.

A12—8 to 11 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate coarse prismatic structure parting to moderate medium and fine subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; neutral; clear smooth boundary.

B2t—11 to 20 inches; dark grayish brown (2.5Y 4/2) silty clay loam, very dark grayish brown (2.5Y 3/2) moist; strong coarse prismatic structure parting to strong medium and fine angular blocky; hard, friable, sticky and plastic; common very fine roots; clay films on faces of peds; neutral; gradual wavy boundary.

C1ca—20 to 34 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; moderate medium and coarse prismatic structure parting to moderate medium and fine subangular blocky; hard, friable, sticky and plastic; common very fine roots; common fine irregular segregated carbonates; violent effervescence; moderately alkaline; gradual wavy boundary.

C2ca—34 to 48 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure parting to moderate medium and fine subangular blocky; hard, friable, sticky and plastic; common fine irregularly segregated carbonates; violent effervescence; moderately alkaline; gradual wavy boundary.

C3—48 to 60 inches; grayish brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) moist; weak medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; violent effervescence; moderately alkaline.

The mollic epipedon is from 16 to 26 inches thick.

The A horizon has color value of 4 or 5. Value is 2 or 3 if the soil is moist. The A horizon is silt loam or silty clay loam. The B2t horizon has hue of 2.5Y or 10YR, value of 4 or 5, and chroma of 2 or 3. It has value of 2 or 4 if the soil is moist. It is silty clay loam or silty clay. The C horizon has color value of 5 through 7. It has value of 4 or 5 if the soil is moist. It is loam, silt loam, silty clay loam, clay loam, or silty clay.

Harriet series

The Harriet series consists of deep, poorly drained soils that are very slowly permeable. These soils are on terraces and flood plains. They formed in calcareous, stratified alluvium. Slope is 0 to 1 percent.

Harriet soils are similar to Heil soils and are commonly adjacent to Dimmick, Heil, and Rhoades soils on the landscape. Heil soils have carbonates at a depth of more than 15 inches. They are in shallow depressions. Rhoades soils are moderately well drained and are on upland plains and terraces and in swales. Dimmick soils do not have a natric horizon. They are in slightly concave lake basins and depressions.

Typical pedon of Harriet silt loam, 2,580 feet north and 2,340 feet east of the southwest corner of sec. 4, T. 145 N., R. 95 W.

A2—0 to 2 inches; gray (10YR 6/1) silt loam, dark gray (10YR 4/1) moist; weak medium prismatic structure parting to weak medium platy; hard, friable, slightly sticky and slightly plastic; common very fine roots; slight effervescence; moderately alkaline; abrupt smooth boundary.

B2t—2 to 10 inches; grayish brown (2.5Y 5/2) silty clay loam, very dark grayish brown (2.5Y 3/2) moist; strong medium columnar structure parting to strong medium blocky; very hard, very firm, sticky and plastic; few fine and common very fine roots; few fine faint white (N 8/0) masses of salt crystals in the lower part; gray (10YR 6/1) ped coatings; slight

effervescence; strongly alkaline; clear wavy boundary.

C1sa—10 to 30 inches; grayish brown (2.5Y 5/2) silty clay loam, very dark grayish brown (2.5Y 3/2) moist; massive; hard, friable, sticky and plastic; few very fine roots; few medium distinct white (N 8/0) masses of salt crystals; violent effervescence; strongly alkaline; gradual smooth boundary.

C2sa—30 to 48 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; massive; hard, firm, sticky and plastic; few very fine roots; common coarse distinct light gray (2.5Y 7/2) masses of salt crystals; violent effervescence; strongly alkaline; gradual smooth boundary.

C3—48 to 60 inches; light olive gray (5Y 6/2) stratified silty clay and sandy clay loam, olive (5Y 5/3) moist; massive; hard, firm, sticky and plastic; few very fine roots; common coarse distinct white (5Y 8/1) masses of salt crystals; violent effervescence; strongly alkaline.

The solum ranges from 10 to 18 inches in thickness. Salts are visible at a depth of 4 to 11 inches and may be throughout the profile.

Some pedons have a thin, dark surface horizon 1 to 2 inches thick. The A2 horizon ranges from 1 to 5 inches thick. It typically is at the surface. It has hue of 10YR or 2.5Y and value of 5 or 6. Value is 3 or 4 if the soil is moist. The A2 horizon typically is silt loam, but in some pedons it is loam. The B2t horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. It has value of 2 or 3 if the soil is moist. It typically is silty clay loam, but in some places it is clay loam or clay. The C horizon has hue of 10YR, 2.5Y, or 5Y; value of 4 through 7; and chroma of 1 through 3. It has value of 3 through 5 if the soil is moist. It is loam, silty clay loam, clay loam, sandy clay loam, or silty clay. A dark colored, buried A horizon is below a depth of 30 inches in some pedons. Mottles are in some pedons.

Havrelon series

The Havrelon series consists of deep, well drained soils that are moderately permeable. These soils are on flood plains and fans. They formed in recent alluvium. Slope ranges from 0 to 6 percent.

Havrelon soils are commonly adjacent to Banks soils and the Trembles Variant on the landscape. Banks soils and the Trembles Variant have more sand than the Havrelon soils.

Typical pedon of Havrelon silt loam, 120 feet west and 390 feet south of the northeast corner of sec. 32, T. 143 N., R. 96 W.

A1—0 to 4 inches; grayish brown (2.5Y 5/2) silt loam, dark grayish brown (2.5Y 4/2) moist; weak very fine platy structure; soft, very friable, slightly sticky and slightly plastic; few coarse and many fine roots; slight effervescence; mildly alkaline; clear smooth boundary.

C1—4 to 12 inches; light brownish gray (2.5Y 6/2) silt loam, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure parting to weak thin platy; soft, very friable, slightly sticky and slightly plastic; few coarse and many fine roots; slight effervescence; mildly alkaline; clear smooth boundary.

C2—12 to 20 inches; light brownish gray (2.5Y 6/2) silt loam, dark grayish brown (2.5Y 4/2) moist; weak very coarse prismatic structure parting to weak thin and very thin platy; soft, very friable, slightly sticky and slightly plastic; few fine roots; strong effervescence; moderately alkaline; gradual smooth boundary.

C3—20 to 38 inches; light gray (2.5Y 7/2) silt loam, grayish brown (2.5Y 5/2) moist; massive; soft, very friable, slightly sticky and slightly plastic; few fine roots; thin stratified sand lens; strong effervescence; moderately alkaline; abrupt smooth boundary.

Ab—38 to 41 inches; gray (10YR 5/1) silt loam, very dark gray (10YR 3/1) moist; massive; soft, very friable, slightly sticky and slightly plastic; very few fine roots; strong effervescence; moderately alkaline; abrupt smooth boundary.

C4—41 to 60 inches; light brownish gray (2.5Y 6/2) silt loam, dark grayish brown (2.5Y 4/2) moist; common fine prominent yellowish brown (10YR 5/6) mottles; massive; soft, very friable, slightly sticky and slightly plastic; very few fine roots; strong effervescence; moderately alkaline.

The solum is 2 to 13 inches thick. The A horizon has hue of 2.5Y or 10YR, value of 5 or 6, and chroma of 1 or 2. Value is 3 through 5 if the soil is moist. The A horizon typically is silt loam, but in some pedons it is loam or very fine sandy loam. The C horizon has hue of 2.5Y, 10YR, or 5Y; value of 5 through 7; and chroma of 1 through 3. It has value of 4 through 6 if the soil is moist. Some pedons do not have a thin, dark colored, buried A horizon. Some pedons have strata of fine sandy loam and sandy loam.

Heil series

The Heil series consists of deep, poorly drained soils that are very slowly permeable. These soils are on uplands. They formed in clayey alluvium. Slope is 0 to 1 percent.

Heil soils are similar to Harriet soils and are commonly adjacent to Dimmick, Harriet, and Williams soils on the landscape. Harriet soils have carbonates within 10 inches of the surface. They are on low terraces and bottom lands. Dimmick soils do not have a natric horizon. Dimmick and Heil soils are in similar positions on the landscape. Williams soils are well drained and are on till uplands.

Typical pedon of Heil silty clay loam, 200 feet east and 300 feet south of the northwest corner of sec. 33, T. 146 N., R. 95 W.

A2—0 to 3 inches; gray (5Y 6/1) silty clay loam, gray (5Y 5/1) moist; moderate medium prismatic structure parting to weak medium platy; soft, very friable, slightly sticky and slightly plastic; many fine roots; neutral; abrupt wavy boundary.

B21t—3 to 6 inches; gray (5Y 5/1) silty clay, dark olive gray (5Y 3/2) moist; few fine prominent dark yellowish brown (10YR 4/6) mottles; strong coarse prismatic structure parting to strong medium subangular blocky; slightly hard, friable, sticky and slightly plastic; few fine roots along cracks; neutral; gradual smooth boundary.

B22t—6 to 18 inches; gray (5Y 5/1) silty clay, dark gray (5Y 4/1) moist; strong medium prismatic structure parting to strong medium subangular blocky; spots of A2 on ped surfaces; hard, firm, very sticky and plastic; few fine roots; slight effervescence in lower part; mildly alkaline; gradual smooth boundary.

B3cs—18 to 27 inches; light olive gray (5Y 6/2) silty clay, olive gray (5Y 5/2) moist; strong medium prismatic structure parting to strong medium subangular blocky; hard, firm, very sticky and plastic; very few fine roots; common fine nests of gypsum crystals; strong effervescence; moderately alkaline; gradual wavy boundary.

C1g—27 to 38 inches; light olive gray (5Y 6/2) silty clay, olive gray (5Y 5/2) moist; massive; extremely hard, very firm, very sticky and plastic; slight effervescence; moderately alkaline; gradual wavy boundary.

C2g—38 to 60 inches; gray (5Y 6/1) clay loam, olive gray (5Y 5/2) moist; massive; extremely hard, very firm, very sticky and plastic; violent effervescence; strongly alkaline.

Carbonates range in depth from 15 inches to more than 26 inches. The A2 horizon has hue of 10YR, 2.5Y, or 5Y and value of 4 through 6. Value is 3 through 5 if the soil is moist. The A2 horizon is silt loam, silty clay loam, or silty clay. The B2t horizon has hue of 10YR, 2.5Y, or 5Y; value of 4 or 5; and chroma of 1 or 2. It has value of 3 or 4 if the soil is moist. It is silty clay or clay. The Cg horizon is silty clay, clay, or clay loam. Clay loam till or soft, weathered bedrock is found below a depth of 40 inches in some pedons.

Hidatsa series

The Hidatsa series consists of deep, well drained soils that are moderately deep to gravel. These soils are on terraces and fans. Permeability is moderate in the solum and rapid in the underlying material. These soils formed in loamy alluvium over very gravelly outwash material. Slope ranges from 1 to 6 percent.

Hidatsa soils are similar to Bowdle and Ruso soils and are commonly adjacent to Arnegard, Baahish, Farland, Lakoa, and Shambo soils on the landscape. Bowdle and Ruso soils have fewer coarse fragments in the profile than the Hidatsa soils. Arnegard, Farland, and Shambo soils do not have gravel. The Bowdle, Ruso, Arnegard, Farland, and Shambo soils and the Hidatsa soils are in similar positions on the landscape. Lakoa soils have an A2 horizon and an argillic horizon. Baahish and Lakoa soils are on steep uplands. Baahish soils have gravelly material within a depth of 15 inches.

Typical pedon of Hidatsa loam, 3 to 6 percent slopes, in alfalfa, 3,200 feet east and 100 feet south of the northwest corner, sec. 27, T. 147 N., R. 96 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; common very fine roots; neutral; abrupt smooth boundary.

B21—6 to 16 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; moderate coarse prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; few fine and very fine roots; neutral; clear wavy boundary.

B22—16 to 22 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; 1 percent limestone pebbles; few very fine roots; neutral; gradual wavy boundary.

IIC—22 to 60 inches; light brownish gray (10YR 6/2) very gravelly sandy loam, grayish brown (10YR 5/2) moist; single grain; loose, nonsticky and nonplastic; few very fine roots; violent effervescence; mildly alkaline.

The thickness of the solum, or the depth to very gravelly sandy loam, commonly is about 20 to 24 inches but ranges from 18 to 28 inches. The 10- to 40-inch control section averages more than 50 percent, by volume, limestone gravel. The mollic epipedon is 16 to 26 inches thick and includes the B horizon.

The A horizon has color value of 4 or 5 and chroma of 1 or 2. It has value of 2 or 3 if the soil is moist. It is loam or fine sandy loam. The B2 horizon has color value of 4 or 5 and chroma of 2 through 4. Value is 3 or 4 if the soil is moist. The B2 horizon is loam or fine sandy loam. Some pedons have a B3ca or Cca horizon. The IIC horizon has hue of 10YR, 2.5Y, or 5Y; value of 5 through 8; and chroma of 2 through 4. It has value of 4 through 7 if the soil is moist.

Lakoa series

The Lakoa series consists of deep, well drained soils that are moderately permeable. These soils are on uplands. They formed in residuum weathered from sandstone and shale. Slope ranges from 15 to 45 percent.

Lakoa soils are similar to Arikara soils and are commonly adjacent to Baahish, Cabba, and Cohagen soils on the landscape. Arikara soils do not have an argillic horizon and are on steep, north- and east-facing side slopes of the Badland areas. Baahish soils are shallow to limestone gravel. Cabba and Cohagen soils are shallow to bedrock. Baahish, Cabba, and Cohagen soils are on nearby, steep side slopes and ridgetops.

Typical pedon of Lakoa loam, 15 to 45 percent slopes, 1,200 feet south and 800 feet east of the northwest corner of sec. 10, T. 146 N., R. 96 W.

01—1 inch to 0; litter of partially decomposed leaves and twigs; abrupt smooth boundary.

A1—0 to 1 inch; dark gray (10YR 4/1) loam, black (10YR 2/1) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; common very fine to medium roots; slightly acid; clear wavy boundary.

A2—1 inch to 8 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; weak medium platy structure; soft, very friable, nonsticky and nonplastic; few fine and medium roots; slightly acid; abrupt smooth boundary.

B21t—8 to 11 inches; light brownish gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; neutral; abrupt smooth boundary.

B22t—11 to 22 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak moderate prismatic structure parting to coarse medium subangular blocky; hard, friable, sticky and plastic; few medium roots; neutral; abrupt smooth boundary.

B23t—22 to 29 inches; grayish brown (2.5Y 5/2) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate medium prismatic structure parting to coarse medium subangular blocky; hard, friable, sticky and plastic; few medium roots; few pebbles; neutral; clear wavy boundary.

C1ca—29 to 44 inches; light gray (2.5Y 7/2) loam, light brownish gray (2.5Y 6/2) moist; massive; hard, friable, slightly sticky and slightly plastic; few pebbles; many soft masses of carbonates; strong effervescence; mildly alkaline; clear wavy boundary.

C2—44 to 60 inches; light brownish gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; massive; soft, loose, nonsticky and nonplastic; few coarse fragments; slight effervescence; mildly alkaline.

The solum ranges from 22 to 36 inches in thickness. Carbonates are at a depth of 25 to 60 inches or more. Some pedons do not have an A1 horizon.

The A1 horizon has color value of 4 or 5 and chroma of 1 through 3. Value is 2 or 3 if the soil is moist. The A2 horizon has color value of 6 or 7 and chroma of 2 or 3. It has value of 4 or 5 if the soil is moist. It is loam or very fine sandy loam. The B2t horizon has color value of 5 through 7 and chroma of 2 through 5. Value is 4 through 6 if the soil is moist. The C horizon has color value of 5 through 7 and chroma of 3 or 4. It has value of 4 through 6 if the soil is moist. It is loam, clay loam, or sandy loam.

Lawther series

The Lawther series consists of deep, well drained soils that are slowly permeable. These soils are on uplands. They formed in calcareous silty clay or clay sediment. Slope ranges from 1 to 6 percent.

Lawther soils are similar to Grail and Savage soils and are commonly adjacent to Farland, Grail, and Savage soils on the landscape. Farland, Grail, and Savage soils have an argillic horizon.

Typical pedon of Lawther silty clay, 1 to 3 percent slopes, in a cultivated area, 90 feet west and 330 feet north of the southeast corner of sec. 11, T. 142 N., R. 95 W.

Ap—0 to 4 inches; grayish brown (2.5Y 5/2) silty clay, very dark grayish brown (2.5Y 3/2) moist; weak fine granular structure; hard, friable, sticky and plastic; few fine roots; slight effervescence; mildly alkaline; abrupt smooth boundary.

A12—4 to 10 inches; dark grayish brown (2.5Y 4/2) silty clay, very dark grayish brown (2.5Y 3/2) moist; strong very fine subangular blocky; very hard, firm, sticky and plastic; few fine roots; mildly alkaline; clear smooth boundary.

B2—10 to 30 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; strong very fine subangular blocky structure; very hard, firm, sticky and plastic; few fine roots; few fine masses of gypsum crystals in the lower part; strong effervescence; moderately alkaline; gradual smooth boundary.

C1cs—30 to 54 inches; olive gray (5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; weak very fine subangular blocky structure; hard, firm, sticky and plastic; few fine masses of gypsum crystals; strong effervescence; moderately alkaline; gradual wavy boundary.

C2cs—54 to 60 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; massive; hard, firm, sticky and plastic; many large soft masses of segregated carbonates; many fine masses of gypsum crystals; strong effervescence; moderately alkaline.

The solum ranges from 20 inches to more than 40 inches in thickness. These soils typically are calcareous at the surface, but some do not have carbonates within a depth of 6 to 20 inches of the surface. When dry, these soils have 1/2- to 2-inch cracks that extend downward through the solum.

The A horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 1 or 2. It has value of 2 or 3 if the soil is moist. It is silty clay, clay, or silty clay loam. The B horizon has hue of 2.5Y or 5Y, value of 4 or 5, and chroma of 1 through 3. Value is 2 through 4 if the soil is moist. The B horizon is silty clay or clay. The C horizon has color value of 4 through 6 and chroma of 2 or 3. It has value of 3 through 5 if the soil is moist. It is silty clay, clay, or silty clay loam.

Lefor series

The Lefor series consists of moderately deep, well drained soils that are moderately permeable. These soils are on uplands. They formed in residuum weathered from soft, sedimentary beds that are high in kaolinite and micaceous minerals. Slope ranges from 1 to 9 percent. These soils do not have a mollic epipedon, which is definitive for the Lefor series, but this difference does not alter their usefulness or behavior.

Lefor soils are similar to Vebar soils and are commonly adjacent to Amor, Morton, and Vebar soils on the landscape. Amor soils do not have an argillic horizon. Morton soils have more silt and less sand than Lefor soils. Vebar soils have more sand than Lefor soils and do not have an argillic horizon. Amor, Morton, and Vebar soils are on nearby uplands.

Typical pedon of Lefor fine sandy loam, 6 to 9 percent slopes, 1,360 feet west and 1,330 feet north of the southeast corner of sec. 23, T. 146 N., R. 93 W.

Ap—0 to 8 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; slightly acid; abrupt smooth boundary.

B1—8 to 19 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; weak coarse prismatic structure parting to moderate coarse subangular blocky; hard, friable, slightly sticky and slightly plastic; many fine roots; slightly acid; clear smooth boundary.

B2t—19 to 28 inches; light gray (2.5Y 7/2) sandy clay loam, light yellowish brown (2.5Y 6/4) moist; strong coarse prismatic structure parting to strong medium subangular blocky; hard, firm, slightly sticky and slightly plastic; few fine roots; neutral; gradual wavy boundary.

Cr—28 to 60 inches; white (2.5Y 8/2) soft sandstone, pale yellow (2.5Y 7/4) moist; strong effervescence; moderately alkaline.

The solum ranges from 20 to 30 inches in thickness. Soft sandstone ranges in depth from 20 to 40 inches.

The A horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 or 3. It has value of 2 or 3 if the soil is moist. It is fine sandy loam, sandy loam, or loam. The B1 horizon has hue of 10YR or 2.5Y, value of 4 through 6, and chroma of 2 through 4. Value is 2 through 4 if the soil is moist. The B1 horizon is sandy loam, fine sandy loam, or loam. The B2t horizon has hue of 2.5Y or 10YR, value of 5 through 7, and chroma of 2 through 4. It has value of 4 through 6 if the soil is moist. It is sandy clay loam or loam. The Cr horizon consists of weathered sandstone or shale beds that have a high amount of kaolinitic clay. These soils have a low cation exchange capacity.

Lihen series

The Lihen series consists of deep, well drained soils that are rapidly permeable. These soils are on uplands. They formed in wind- or water-deposited sandy material. Slope ranges from 1 to 15 percent.

Lihen soils are commonly adjacent to Parshall and Vebar soils on the landscape. Parshall and Vebar soils have more clay and silt than Lihen soils. Vebar soils are moderately deep. Parshall soils are in swales and depressions along drainageways. Vebar and Lihen soils are in similar positions on the landscape.

Typical pedon of Lihen loamy fine sand, 6 to 15 percent slopes, 700 feet south and 2,425 feet east of the northwest corner of sec. 8, T. 145 N., R. 94 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; loose, very friable, slightly sticky and nonplastic; common fine roots; neutral; abrupt smooth boundary.

A12—6 to 18 inches; dark grayish brown (10YR 4/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to weak medium subangular blocky; soft, very friable, slightly sticky and nonplastic; few fine roots; neutral; gradual smooth boundary.

AC—18 to 32 inches; brown (10YR 5/3) loamy fine sand, dark brown (10YR 3/3) moist; weak coarse prismatic structure parting to weak fine granular; soft, very friable, slightly sticky and nonplastic; few fine roots; mildly alkaline; gradual smooth boundary.

C1ca—32 to 48 inches; light olive brown (2.5Y 5/4) fine sand, olive brown (2.5Y 4/4) moist; single grain; loose, nonsticky and nonplastic; very few fine roots; lime coated sand particles; violent effervescence; moderately alkaline; gradual smooth boundary.

C2ca—48 to 60 inches; light brownish gray (2.5Y 6/2) fine sand, grayish brown (2.5Y 5/2) moist; single grain; loose, nonsticky and nonplastic; lime coated sand particles; strong effervescence; moderately alkaline.

Carbonates range in depth from 12 to 36 inches.

The A horizon has hue of 10YR or 2.5Y and value of 4 or 5. Value is 2 or 3 if the soil is moist. The A horizon is loamy fine sand or loamy sand. The C horizon has hue of 10YR or 2.5Y, value of 4 through 7, and chroma of 2 through 4. It has value of 3 through 5 if the soil is moist. It is loamy fine sand, fine sand, or sand.

Moreau series

The Moreau series consists of moderately deep, well drained soils that are slowly permeable. These soils are on uplands. They formed in residuum from calcareous shales. Slope ranges from 1 to 9 percent. These soils have a lighter colored surface layer than that defined as the range for the Moreau series. This difference does not alter the use or behavior of the soil.

Moreau soils are similar to Lawther, Regent, and Savage soils and are commonly adjacent to Cabba, Lawther, Morton, Regent, Savage, and Wayden soils on the landscape. Lawther and Savage soils do not have soft bedrock within a depth of 40 inches. Regent and Savage soils have an argillic horizon. Cabba and Wayden soils have bedrock within a depth of 10 to 20 inches and are on steeper ridgetops and side slopes. Lawther and Savage soils are in swales and on fans and terraces. Morton soils have less clay than Moreau soils.

Typical pedon of Moreau silty clay, 3 to 6 percent slopes, 30 feet north and 2,000 feet east of the southwest corner of sec. 18, T. 143 N., R. 95 W.

Ap—0 to 7 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak coarse subangular blocky structure; extremely hard, very firm, very sticky and very plastic; mildly alkaline; abrupt smooth boundary.

B21—7 to 18 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure parting to strong fine subangular blocky; extremely hard, very firm, very sticky and very plastic; strong effervescence; moderately alkaline; gradual wavy boundary.

B22—18 to 25 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure parting to strong fine subangular blocky; extremely hard, very firm, very sticky and very plastic; common medium irregular masses of carbonates; strong effervescence; moderately alkaline; clear wavy boundary.

C—25 to 32 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure; extremely hard, very firm, very sticky and very plastic; few gypsum crystals; many medium irregular masses of carbonates; strong effervescence; moderately alkaline; clear wavy boundary.

Cr1—32 to 40 inches; light brownish gray (2.5Y 6/2) soft platy shale, grayish brown (2.5Y 5/2) moist; common masses of gypsum crystals; mildly alkaline; clear wavy boundary.

Cr2—40 to 60 inches; olive (5Y 5/4) soft platy shale, olive (5Y 4/4) moist; common masses of gypsum crystals; mildly alkaline.

Soft, platy shale bedrock is at a depth of 20 to 40 inches.

The A horizon has hue of 2.5Y or 10YR and value of 4 or 5. Value is 3 or 4 if the soil is moist. The A horizon typically is silty clay, but in some pedons it is silty clay loam or clay. The B2 horizon has hue of 2.5Y or 10YR, value of 5 or 6, and chroma of 2 or 3. It has value of 3 through 5 if the soil is moist. The C horizon has hue of 2.5Y or 5Y, value of 5 through 7, and chroma of 2 through 4. It has value of 4 through 6 if the soil is moist. Few to many gypsum crystals are in the C horizon and in the soft shale bedrock.

Moreau Variant

The Moreau Variant consists of shallow, moderately well drained soils that are slowly permeable. These soils are on uplands. They formed in clayey and silty material weathered from soft bedrock. The soft, sedimentary beds have a high amount of kaolinite and micaceous minerals. Slope ranges from 1 to 6 percent.

The Moreau Variant is similar to Lefor and Wayden soils and commonly adjacent to Amor, Belfield, Lefor, Morton, and Regent soils on the landscape. Lefor soils have less clay than the Moreau Variant. These two soils are in similar positions on the landscape. Wayden soils have more clay. They are on the upper part of side slopes, knolls, and ridge crests. Amor soils do not have an argillic horizon. Amor, Morton, and Regent soils have soft bedrock at a depth of 20 to 40 inches. Amor, Morton, and Regent soils and the Moreau Variant are in similar positions on the landscape. Belfield soils have a natric horizon and are in slightly concave swales and on foot slopes. Morton soils have less clay than the Moreau Variant.

Typical pedon of Moreau Variant clay loam, 1 to 6 percent slopes, 100 feet east and 2,590 feet south of the northwest corner of sec. 26, T. 141 N., R. 95 W.

Ap—0 to 6 inches; light brownish gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; slightly hard, very friable, slightly sticky and plastic; few very fine roots; medium acid; abrupt smooth boundary.

B2—6 to 12 inches; grayish brown (10YR 5/2) silty clay, very dark grayish brown (10YR 3/2) moist; strong coarse prismatic structure parting to weak fine subangular blocky; very hard, firm, sticky and plastic; few very fine roots; slightly acid; clear smooth boundary.

C—12 to 17 inches; light gray (5Y 7/1) silty clay loam, gray (5Y 6/1) moist; moderate medium prismatic

structure parting to moderate medium subangular blocky; very hard, friable, slightly sticky and slightly plastic; few very fine roots; neutral; clear smooth boundary.

Cr—17 to 60 inches; white (N 8/0) soft clayey bedrock, light gray (N 7/0) moist; nests of salt crystals; mildly alkaline.

Soft bedrock is at a depth of 10 to 20 inches.

The A horizon has color value of 5 or 6 and chroma of 2 or 3. Value is 3 or 4 if the soil is moist. The A horizon typically is clay loam, but in some pedons it is loam, silt loam, or silty clay loam. The B2 horizon has hue of 10YR or 2.5Y, value of 5 or 6, and chroma of 2 through 4. It has value of 3 or 4 if the soil is moist. It is silty clay or clay loam. The C horizon has hue of 10YR, 2.5Y, or 5Y; value of 6 through 8; and chroma of 1 through 3. It has value of 5 through 7 if the soil is moist. It is clay loam or silty clay loam.

Morton series

The Morton series consists of moderately deep, well drained soils that are moderately permeable. These soils are on uplands. They formed in material weathered from soft, silty shale and siltstone. Slope ranges from 1 to 9 percent.

Morton soils are similar to Farland soils and are commonly adjacent to Amor, Belfield, Farland, Grail, Regent, Rhoades, and Sen soils on the landscape. Farland soils do not have soft bedrock within a depth of 40 inches and are on lower fans and terraces. Amor, Belfield, Regent, Rhoades, and Sen soils and Morton soils are on in the same position on the landscape. Amor and Sen soils do not have an argillic horizon. Belfield and Rhoades soils have a natric horizon. Regent soils are fine textured. Grail soils are pachic and are in nearby swales and depressions.

Typical pedon of Morton silt loam, 3 to 6 percent slopes, 1,520 feet south and 1,940 feet west of the northeast corner of sec. 15, T. 144 N., R. 94 W.

Ap—0 to 5 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and medium roots; neutral; abrupt smooth boundary.

B21t—5 to 11 inches; dark yellowish brown (10YR 4/4) silt loam, dark brown (10YR 3/3) moist; moderate medium prismatic structure parting to strong medium blocky; very hard, firm, sticky and plastic; common fine roots; many moderately thick clay films on faces of peds; neutral; gradual wavy boundary.

B22t—11 to 27 inches; light yellowish brown (2.5Y 6/4) silt loam, olive brown (2.5Y 4/4) moist; moderate medium prismatic structure parting to moderate medium blocky; hard, firm, sticky and plastic; common fine roots; common thin clay films; neutral; gradual irregular boundary.

Cca—27 to 37 inches; light olive gray (5Y 6/2) silt loam, olive gray (5Y 5/2) moist; few fine distinct yellowish brown (10YR 5/6) mottles; weak thin platy structure; hard, firm, slightly sticky and slightly plastic; few fine roots; common fine soft masses of carbonates; violent effervescence; moderately alkaline; gradual irregular boundary.

Cr—37 to 60 inches; light olive gray (5Y 6/2) soft platy siltstone, olive gray (5Y 4/2) moist; few fine roots; slight effervescence; moderately alkaline.

Soft bedrock ranges in depth from 20 to 40 inches. Carbonates begin at a depth of 11 to 30 inches.

The A horizon has color value of 4 or 5. Value is 2 or 3 if the soil is moist. The A horizon is silt loam or loam. The B2t horizon is silt loam or silty clay loam. The Cca horizon has both diffused and segregated lime.

Noonan series

The Noonan series consists of deep, moderately well drained soils that are slowly permeable. These soils are on uplands. They formed in calcareous till. Slope ranges from 3 to 9 percent.

Noonan soils are similar to Belfield and Daglum soils and are commonly adjacent to Flaxton, Williams, and Zahl soils on the landscape. Belfield and Daglum soils are fine textured and do not have till within 40 inches of the surface. Belfield and Daglum soils are on alluvial terraces and in swales. Flaxton, Williams, and Zahl soils do not have a natric horizon. Flaxton and Williams soils are on adjacent till uplands. Zahl soils are on upper crests and ridges.

Typical pedon of Noonan loam from an area of Williams-Noonan loams, 3 to 6 percent slopes, 2,220 feet south and 250 feet east of the northwest corner of sec. 33, T. 144 N., R. 92 W.

A1—0 to 7 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to weak medium and fine subangular blocky; soft, friable, slightly sticky and slightly plastic; many fine roots; few stones on surface; neutral; clear wavy boundary.

A2—7 to 8 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; weak medium prismatic structure parting to weak fine platy; soft, very friable, nonsticky and nonplastic; many fine roots; few pebbles; neutral; abrupt wavy boundary.

B21t—8 to 15 inches; dark brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; strong medium and coarse columnar structure parting to strong medium blocky; very hard, very firm, sticky and plastic; few fine roots in peds and many fine roots on faces of peds; light brownish gray (10YR 6/2) coats on top

and sides of peds; stains on prism faces; few pebbles; mildly alkaline; clear wavy boundary.

B22t—15 to 21 inches; dark brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; strong medium prismatic structure parting to moderate medium subangular blocky; very hard, very firm, sticky and plastic; few fine roots through peds and many fine roots on faces of peds; few pebbles; few fine irregularly shaped soft masses of salt crystals in lower part; slight effervescence; strongly alkaline; abrupt wavy boundary.

C1casa—21 to 32 inches; light olive brown (2.5Y 5/4) clay loam, olive brown (2.5Y 4/4) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; hard, firm, sticky and plastic; very few fine roots; few pebbles; common masses of carbonates and salt crystals; violent effervescence; strongly alkaline; gradual wavy boundary.

C2—32 to 60 inches; light gray (2.5Y 7/2) clay loam, grayish brown (2.5Y 5/2) moist; massive; hard, firm, sticky and plastic; few pebbles; common masses of carbonates and salt crystals; strong effervescence; strongly alkaline.

The A horizon has color value of 3 through 5 and chroma of 2 or 3. It has value of 2 or 3 if the soil is moist. It typically is loam, but in some pedons it is clay loam. Some pedons do not have an A2 horizon. The B2t horizon has hue of 10YR or 2.5Y, value of 3 through 6 and chroma of 2 or 3. Value is 2 through 4 if the soil is moist. The C horizon has hue of 2.5Y or 5Y, value of 5 through 7 and chroma of 2 through 4. It has value of 4 through 6 if the soil is moist. Some pedons have soft sedimentary beds below a depth of 40 inches.

Parshall series

The Parshall series consists of deep, well drained soils that are moderately rapidly permeable. These soils are on terraces and uplands. They formed in alluvium that is fine sandy loam. Slope ranges from 1 to 9 percent.

Parshall soils are similar to Arnegard soils and are commonly adjacent to Straw and Vebar soils on the landscape. Arnegard soils are fine loamy. Vebar soils have a mollic epipedon less than 16 inches thick, are moderately deep, and on side slopes and foot slopes of uplands. Straw soils have more clay than Parshall soils and are on flood plains.

Typical pedon of Parshall fine sandy loam, 1 to 6 percent slopes, 315 feet south and 855 feet east of the northwest corner of sec. 19, T. 145 N., R. 93 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak coarse granular structure; slightly hard, friable, slightly sticky and slightly plastic; few medium and coarse and many very fine roots; neutral; abrupt smooth boundary.

A12—7 to 15 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; few medium and coarse and common very fine roots; neutral; clear irregular boundary.

B2—15 to 27 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; few medium and coarse and many very fine roots; about 1 percent pebbles; neutral; gradual wavy boundary.

C1—27 to 37 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure; soft, very friable, nonsticky and nonplastic; common very fine roots; about 10 percent pebbles; neutral; clear wavy boundary.

C2—37 to 49 inches; yellowish brown (10YR 5/4) fine sandy loam, dark brown (10YR 4/3) moist; massive; soft, very friable, slightly sticky and slightly plastic; few very fine roots; neutral; diffuse wavy boundary.

C3—49 to 60 inches; light olive brown (2.5Y 5/4) fine sandy loam, olive brown (2.5Y 4/4) moist; massive; soft, friable, nonsticky and nonplastic; few very fine and medium roots; mildly alkaline.

The solum ranges from 18 to 36 inches in thickness. The mollic epipedon is 16 to 35 inches thick. Carbonates range in depth from 25 to 60 inches.

The A horizon has color value of 2 through 4. Value is 2 or 3 if the soil is moist. The A horizon typically is fine sandy loam, but in some pedons it is loam. The B horizon has color value of 4 or 5 and chroma of 2 or 3. It has value of 2 or 3 if the soil is moist. The C horizon typically is fine sandy loam, but in some pedons it is loamy fine sand. In some pedons one or more buried A horizons are below the solum. Some pedons have gravelly substrata below a depth of 40 inches. Some pedons have a Cca horizon.

Regent series

The Regent series consists of moderately deep, well drained soils that are slowly permeable. These soils are on uplands. They formed in weathered, calcareous, soft shale. Slope ranges from 1 to 9 percent.

Regent soils are similar to Grail, Moreau, and Savage soils and are commonly adjacent to them on the landscape. Grail soils have a mollic epipedon more than 16 inches thick. They are in concave swales and depressions. Moreau soils do not have an argillic horizon. Moreau and Regent soils are in similar positions on the landscape. Savage soils do not have soft bedrock

within 40 inches of the surface. They are on nearby terraces and fans.

Typical pedon of Regent silty clay loam, 3 to 6 percent slopes, 390 feet south and 2,085 feet east of the northwest corner of sec. 13, T. 143 N., R. 94 W.

Ap—0 to 8 inches; grayish brown (2.5Y 5/2) silty clay loam, very dark grayish brown (2.5Y 3/2) moist; weak medium subangular blocky structure parting to moderate fine granular; hard, firm, sticky and plastic; common fine roots; neutral; clear smooth boundary.

B21t—8 to 14 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; moderate coarse prismatic structure parting to moderate medium subangular blocky; hard, firm, sticky and plastic; common fine roots; mildly alkaline; clear smooth boundary.

B22t—14 to 24 inches; light brownish gray (2.5Y 6/2) silty clay, dark grayish brown (2.5Y 4/2) moist; moderate coarse prismatic structure parting to moderate medium subangular blocky; very hard, firm, sticky and plastic; common fine and very fine roots; slight effervescence; mildly alkaline; clear wavy boundary.

B3ca—24 to 33 inches; light olive gray (5Y 6/2) silty clay loam, olive gray (5Y 5/2) moist; weak medium prismatic structure parting to moderate medium subangular blocky; hard, firm, slightly sticky and slightly plastic; fine soft masses of carbonates; strong effervescence; moderately alkaline; gradual wavy boundary.

Cr—33 to 60 inches; pale olive (5Y 6/3) soft shale, olive gray (5Y 5/2) moist; strong effervescence; moderately alkaline.

The soft, sedimentary bedrock ranges in depth from 20 to 40 inches. The mollic epipedon is 7 to 16 inches thick.

The A horizon has hue of 2.5Y or 10YR, value of 4 or 5, and chroma of 2 or 3. It has value of 2 or 3 if the soil is moist. It typically is silty clay loam, but in some pedons it is silty clay. The B2t horizon has hue of 2.5Y, 10YR, or 5Y; value of 4 through 6; and chroma of 2 or 3. It has value of 2 through 4 if the soil is moist. It is silty clay or silty clay loam.

Rhoades series

The Rhoades series consists of deep, moderately well drained soils that are very slowly permeable. These soils are on uplands. They formed from clayey alluvium. Slope ranges from 0 to 15 percent.

Rhoades soils are similar to Daglum soils and are commonly adjacent to Belfield, Brandenburg, Daglum, Farland, Morton, Regent, and Savage soils on the landscape. Belfield and Daglum soils have a thicker surface horizon. Brandenburg, Farland, Morton, Regent, and Savage soils do not have a natric horizon. Brandenburg soils are on adjacent uplands. The Belfield, Daglum, Farland, Morton, Regent, and Savage soils and the Rhoades soils and in similar positions on the landscape.

Typical pedon of Rhoades silt loam, 1 to 6 percent slopes, 800 feet east and 850 feet north of the southwest corner of sec. 12, T. 144 N., R. 94 W.

A2—0 to 3 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; neutral; abrupt irregular boundary.

B2t—3 to 10 inches; dark grayish brown (2.5Y 4/2) silty clay loam, grayish brown (10YR 5/2) coated, very dark grayish brown (2.5Y 3/2) moist; strong medium columnar structure parting to strong medium and fine subangular blocky; very hard, firm, slightly sticky and slightly plastic; few very fine roots; common moderately thick clay films on faces of peds; moderately alkaline; clear wavy boundary.

C1cs—10 to 29 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; strong medium and fine subangular blocky structure; very hard, firm, sticky and plastic; few fine roots; common fine soft masses of carbonates and salt crystals; strong effervescence; moderately alkaline; gradual wavy boundary.

C2—29 to 59 inches; light olive brown (2.5Y 5/4) clay, olive brown (2.5Y 4/4) moist; strong medium and fine subangular blocky structure; very hard, firm, sticky and plastic; few pockets of gravelly loam and boulders; very slight effervescence in small areas of salt crystals; moderately alkaline; gradual smooth boundary.

Cr—59 to 60 inches; light olive gray (5Y 6/2) soft platy shale bedrock, olive gray (5Y 4/2) moist; moderately alkaline.

Some pedons have an A1 horizon. The A2 horizon is 1 inch to 5 inches thick. Soft shale is at a depth of more than 40 inches.

The A2 horizon has color value of 4 or 5. Value is 3 through 5 if the soil is moist. The A2 horizon typically is silt loam, but in some pedons it is loam, clay loam, or silty clay loam. The B2t horizon has color value of 4 or 5. It has value of 2 or 3 if the soil is moist. The C horizon has hue of 2.5Y or 5Y, value of 5 through 7, and chroma of 2 through 4. Value is 4 or 5 if the soil is moist. The C horizon is silty clay, clay, loam, or clay loam. Mottles are common in some pedons.

Ruso series

The Ruso series consists of deep, well drained soils that are moderately deep over sand and gravel. These soils are on outwash plains and stream terraces. They are moderately rapidly permeable in the solum and very

rapidly permeable in the sand and gravel. These soils formed in sandy loam sediment over sand and gravel. Slope ranges from 1 to 9 percent.

Ruso soils are similar to Bowdle and Hidatsa soils and are commonly adjacent to Bowdle, Hidatsa, and Parshall soils on the landscape. Bowdle and Hidatsa soils are loam over very gravelly sandy loam. Parshall soils do not have sand and gravel within 40 inches of the surface. Bowdle and Parshall soils are in similar positions on the landscape. Hidatsa soils are on outwash terraces.

Typical pedon of Ruso sandy loam, 1 to 6 percent slopes, 830 feet east and 900 feet south of the northwest corner of sec. 12, T. 148 N., R. 94 W.

A11—0 to 5 inches; dark grayish brown (10YR 4/2) sandy loam, very dark brown (10YR 2/2) moist; weak medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; many fine and medium roots; neutral; clear wavy boundary.

A12—5 to 10 inches; dark brown (10YR 4/3) sandy loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; common fine and medium roots; neutral; gradual wavy boundary.

B2—10 to 21 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; common fine and medium roots; neutral; clear wavy boundary.

C1ca—21 to 26 inches; light brownish gray (10YR 6/2) coarse sandy loam, brown (10YR 5/3) moist; massive; loose, slightly sticky and nonplastic; few fine roots; about 5 percent gravel; few fine masses of carbonates; violent effervescence; moderately alkaline; gradual wavy boundary.

IIC2—26 to 60 inches; light gray (10YR 7/2) very gravelly sand, grayish brown (10YR 5/2) moist; single grain; loose, nonsticky and nonplastic; 45 percent gravel; strong effervescence; moderately alkaline.

The thickness of the solum and depth to carbonates ranges from 20 to 27 inches. Sand and gravel range in depth from 20 to 36 inches.

The A horizon has color value of 4 or 5. Value is 2 or 3 if the soil is moist. The B2 horizon has hue of 10YR or 2.5Y and value of 4 or 5. It has value of 2 or 3 if the soil is moist. Some pedons have a B3 horizon. The Cca horizon has hue of 10YR or 2.5Y and value of 5 through 7. Value is 4 through 6 if the soil is moist. The Cca horizon is sandy loam or coarse sandy loam and is 2 to 15 percent coarse fragments.

Savage series

The Savage series consists of deep, well drained soils that are slowly permeable. These soils are on uplands. They formed in clayey alluvium. Slope ranges from 1 to 6 percent.

Savage soils are similar to Regent soils and commonly adjacent to Farland, Morton, Regent, and Rhoades soils on the landscape. Regent and Morton soils have soft bedrock at a depth of 20 to 40 inches and are on nearby side slopes and foot slopes. Farland soils have less clay than Savage soils. Rhoades soils have a natric horizon. The Farland and Rhoades soils and the Savage soils are in similar positions on the landscape.

Typical pedon of Savage silty clay loam, 1 to 3 percent slopes, 2,280 feet west and 1,420 feet south of the northeast corner of sec. 15, T. 143 N., R. 94 W.

Ap—0 to 5 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak thick platy structure; very hard, extremely firm, sticky and plastic; few very fine roots; neutral; clear smooth boundary.

B2t—5 to 13 inches; grayish brown (2.5Y 5/2) silty clay, very dark grayish brown (2.5Y 3/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, extremely firm, sticky and plastic; few very fine roots; neutral; clear wavy boundary.

B3ca—13 to 28 inches; light brownish gray (2.5Y 6/2) silty clay, dark grayish brown (2.5Y 4/2) moist; strong coarse prismatic structure parting to moderate medium subangular blocky; very hard, extremely firm, sticky and plastic; few very fine roots; disseminated carbonates throughout; violent effervescence; moderately alkaline; gradual wavy boundary.

C1ca—28 to 42 inches; light brownish gray (2.5Y 6/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak coarse prismatic structure parting to moderate medium subangular blocky; very hard, extremely firm, sticky and plastic; disseminated carbonates throughout; violent effervescence; moderately alkaline; gradual wavy boundary.

C2ca—42 to 60 inches; light brownish gray (2.5Y 6/2) silty clay, dark grayish brown (2.5Y 4/2) moist; weak medium subangular blocky structure; very hard, extremely firm, sticky and plastic; disseminated carbonates throughout; violent effervescence; moderately alkaline.

Carbonates are at a depth of 10 to 20 inches.

The A horizon has hue of 10YR or 2.5Y, value of 4 or 5, and chroma of 2 or 3. It has value of 2 or 3 if the soil is moist. It typically is silty clay loam, but in some pedons it is clay loam or silt loam. The B2t horizon has color

value of 4 or 5, and chroma of 2 or 3. Value is 3 or 4 if moist. The C horizon is silty clay, clay, or silty clay loam.

Searing series

The Searing series consists of deep, well drained soils on uplands. Permeability is moderate in the upper part and very rapid in the lower part. These soils formed in weathered porcelanite. They are moderately deep over shattered porcelanite. Slope ranges from 3 to 9 percent.

Searing soils are similar to Amor soils and are commonly adjacent to Amor, Brandenburg, and Morton soils on the landscape. Amor and Morton soils do not have shattered porcelanite at a depth of 20 to 40 inches as the Searing soils do. The Amor and Morton soils and the Searing soils are in similar positions on the landscape. Brandenburg soils have shattered porcelanite within 20 inches of the surface. They are on steeper slopes and hills.

Typical pedon of Searing loam, 3 to 9 percent slopes, 970 feet north and 1,960 feet east of the southwest corner of sec. 20, T. 145 N., R. 94 W.

A1—0 to 8 inches; dark brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) moist; weak medium subangular blocky structure parting to fine granular; slightly hard, friable, slightly sticky and slightly plastic; many fine and medium roots; neutral; abrupt smooth boundary.

B2—8 to 23 inches; reddish brown (5YR 4/4) loam, dark reddish brown (5YR 3/4) moist; strong coarse prismatic structure parting to moderate medium and coarse subangular blocky; hard, friable, slightly sticky and slightly plastic; common fine roots; mildly alkaline; clear smooth boundary.

C1—23 to 33 inches; reddish yellow (5YR 6/6) channery loam, yellowish red (5YR 4/6) moist; massive; soft, slightly sticky and slightly plastic; 15 percent porcelanite fragments; common fine roots; slight effervescence; mildly alkaline; abrupt smooth boundary.

C2—33 to 60 inches; reddish yellow (5YR 7/6) shattered porcelanite, yellowish red (5YR 4/6) moist; strong effervescence; moderately alkaline.

The thickness of the solum and the depth to carbonates ranges from 10 to 24 inches.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5, and chroma of 2 or 3. It has value of 2 or 3 if the soil is moist. It typically is loam, but in some pedons it is silt loam. The B horizon has hue of 10YR, 7.5YR, or 5YR; value of 4 through 6; and chroma of 2 through 4. It has value of 3 or 4 if the soil is moist. It is loam or silt loam.

Sen series

The Sen series consists of moderately deep, well drained soils that are moderately permeable. These soils are on uplands. They formed in material weathered from stratified, soft siltstone. Slope is 3 to 9 percent.

Sen soils are similar to Amor, Chama, and Morton soils and are commonly adjacent to Amor, Arnegard, Chama, Grail, Morton, and Regent soils on the landscape. Chama soils have a calcareous B horizon. Amor soils have more sand than Sen soils. Morton and Regent soils have an argillic horizon. The Amor, Chama, Morton, Regent, and Sen soils are in similar positions. Arnegard and Grail soils have a mollic epipedon more than 16 inches thick. They are in swales and depressions.

Typical pedon of Sen silt loam, 3 to 6 percent slopes, 550 feet west and 975 feet south of northeast corner of sec. 19, T. 143 N., R. 94 W.

Ap—0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, dark brown (10YR 3/3) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine and medium roots; neutral; abrupt smooth boundary.

B21—7 to 12 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; weak medium and coarse prismatic structure parting to weak fine and medium subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common fine and medium, few very fine roots; neutral; clear wavy boundary.

B22—12 to 18 inches; brown (10YR 5/3) silt loam, dark brown (10YR 4/3) moist; weak medium and coarse prismatic structure parting to weak fine subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; mildly alkaline; clear wavy boundary.

Cca—18 to 34 inches; white (2.5Y 8/2) silt loam, light brownish gray (2.5Y 6/2) moist; weak coarse prismatic structure; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; disseminated carbonates throughout; violent effervescence; moderately alkaline; gradual smooth boundary.

Cr—34 to 60 inches; white (2.5Y 8/2) soft siltstone, light gray (2.5Y 7/2) moist; violent effervescence; moderately alkaline.

The mollic epipedon is 7 to 16 inches thick. Carbonates range in depth from 10 to 20 inches.

The A horizon has color value of 4 or 5, and chroma of 2 or 3. It has value of 2 or 3 if the soil is moist. It is silt loam or loam. The B2 horizon has hue of 2.5Y or 10YR, value of 4 through 6, and chroma of 2 through 4. It has value of 3 through 5 if the soil is moist. It typically is silt loam, but in some pedons it is loam. The Cca horizon has hue of 2.5Y or 5Y, value of 5 through 8, and

chroma of 2 through 4. Value is 4 through 6 if the soil is moist. The Cr horizon is soft siltstone or shale.

Shambo series

The Shambo series consists of deep, well drained soils that are moderately permeable. These soils are on terraces and fans. They are formed in calcareous alluvium that is loam. Slope ranges from 1 to 6 percent.

Shambo soils are similar to Amor and Arnegard soils and are commonly adjacent to Amor, Arnegard, Bowdle, and Farland soils on the landscape. Amor soils have soft bedrock within 20 to 40 inches of the surface. They are on uplands. Arnegard soils have a mollic epipedon more than 16 inches thick. They are in swales and concave depressions. Bowdle soils have sand and gravel within a depth of 20 to 40 inches. Farland soils have an argillic horizon. The Bowdle and Farland soils and the Shambo soils are in similar positions on the landscape.

Typical pedon of Shambo loam, 1 to 3 percent slopes, 1,375 feet south and 980 feet west of the northeast corner of sec. 5, T. 145 N., R. 92 W.

A1—0 to 4 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many fine roots; neutral; clear smooth boundary.

B21—4 to 10 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate coarse prismatic structure parting to moderate coarse angular blocky; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; neutral; abrupt smooth boundary.

B22—10 to 24 inches; grayish brown (2.5Y 5/2) silt loam, dark grayish brown (2.5Y 4/2) moist; moderate coarse prismatic structure parting to moderate coarse subangular blocky; slightly hard, very friable, sticky and plastic; few very fine roots; neutral; abrupt smooth boundary.

B23—24 to 32 inches; light olive brown (2.5Y 5/4) loam, olive brown (2.5Y 4/4) moist; weak medium subangular blocky structure; slightly hard, very friable, nonsticky and nonplastic; few very fine roots; neutral; clear wavy boundary.

C1ca—32 to 39 inches; light brownish gray (2.5Y 6/2) loam, grayish brown (2.5Y 5/2) moist; weak medium prismatic structure; slightly hard, very friable, nonsticky and nonplastic; few very fine roots; few fine masses of carbonates; violent effervescence; moderately alkaline; clear wavy boundary.

C2—39 to 49 inches; light gray (2.5Y 7/2) loam, light brownish gray (2.5Y 6/2) moist; massive; hard, friable, slightly sticky and slightly plastic; violent effervescence; moderately alkaline; clear wavy boundary.

C3—49 to 60 inches; light gray (2.5Y 7/2) silt loam, light brownish gray (2.5Y 6/2) moist; massive; hard, firm, sticky and plastic; violent effervescence; moderately alkaline.

The thickness of the solum and the depth to carbonates ranges from 19 to 32 inches. The mollic epipedon is 7 to 16 inches thick.

The A horizon has color value of 4 or 5 and chroma of 2 or 3. Value is 2 or 3 if the soil is moist. The B horizon has color value of 4 through 6 and chroma of 2 through 4. Value is 3 or 4 if the soil is moist. The Cca horizon has hue of 2.5Y or 10YR, value of 5 through 7, and chroma of 2 through 4. It has value of 4 through 6 if the soil is moist. It typically is loam, but in some pedons it is silt loam. The C horizon has hue of 2.5Y or 5Y, value of 5 through 7, and chroma of 2 through 4. Value is 4 through 6 if the soil is moist. Sand and coarse fragments are at a depth of below 40 inches in some pedons.

Straw series

The Straw series consists of deep, well drained soils that are moderately permeable. These soils are on terraces and flood plains. They formed in alluvium. Slope is 0 to 1 percent.

Straw soils are similar to Havrelon and Velva soils and are commonly adjacent to Grail, Havrelon, Parshall, and Velva soils on the landscape. The Havrelon, Parshall, and Velva soils and the Straw soils are in similar positions on the landscape. Havrelon soils do not have a mollic epipedon. Velva and Parshall soils have more sand than Straw soils. Grail soils have an argillic horizon and are on terraces and fans.

Typical pedon of Straw loam, 700 feet south and 130 feet east of the northwest corner of sec. 24, T. 143 N., R. 95 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium and coarse subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common medium roots; slight effervescence; mildly alkaline; abrupt smooth boundary.

A12—8 to 15 inches; dark grayish brown (2.5Y 4/2) silt loam, very dark grayish brown (2.5Y 3/2) moist; moderate medium and fine prismatic structure parting to weak medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; few fine roots; slight effervescence; mildly alkaline; gradual wavy boundary.

A13—15 to 23 inches; grayish brown (2.5Y 5/2) silt loam, very dark grayish brown (2.5Y 3/2) moist; weak medium and coarse prismatic structure; hard, friable, slightly sticky and slightly plastic; few fine roots; many fine soft masses of carbonates; violent effervescence; moderately alkaline; clear wavy boundary.

C1—23 to 27 inches; grayish brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) moist; massive; soft,

very friable, slightly sticky and slightly plastic; few fine roots; strong effervescence; moderately alkaline; clear wavy boundary.

C2—27 to 60 inches; light brownish gray (2.5Y 6/2) loam, grayish brown (2.5Y 5/2) moist; weak thick platy structure; soft, very friable, slightly sticky and slightly plastic; few fine roots; strong effervescence; moderately alkaline.

The mollic epipedon is 16 to 30 inches thick.

The A horizon has color value of 3 through 5 and chroma of 2 or 3. It has value of 2 or 3 if the soil is moist. It typically is loam, but in some pedons it is silt loam or clay loam. The C horizon has hue of 10YR or 2.5Y, value of 5 through 7, and chroma of 2 or 3. It has value of 3 through 5 if the soil is moist. It is loam or silt loam.

Temvik series

The Temvik series consists of deep, well drained soils that are moderately slowly permeable. These soils are on uplands. They formed in a silty mantle that is over loam or clay loam till. Slope ranges from 3 to 6 percent.

Temvik soils are similar to Farland and Williams soils and are commonly adjacent to Noonan and Williams soils on the landscape. Farland and Williams soils have an argillic horizon. Farland soils are on fans and terraces. The Williams soils and the Temvik soils are in similar positions on the landscape. Noonan soils have a natric horizon and are in slightly concave depressions on uplands.

Typical pedon of Temvik silt loam, 3 to 6 percent slopes, in alfalfa, 1,650 feet north and 100 feet west of the southeast corner of sec. 23, T. 142 N., R. 91 W.

Ap—0 to 6 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; neutral; abrupt smooth boundary.

B21—6 to 16 inches; dark brown (10YR 4/3) silt loam, dark brown (10YR 3/3) moist; moderate medium prismatic structure; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; neutral; clear smooth boundary.

B22—16 to 26 inches; light yellowish brown (2.5Y 6/4) silt loam, olive brown (2.5Y 4/4) moist; weak medium prismatic structure; soft, very friable, slightly sticky and slightly plastic; few very fine roots; neutral; gradual wavy boundary.

B3—26 to 34 inches; light brownish gray (2.5Y 6/2) silt loam, dark grayish brown (2.5Y 4/2) moist; weak medium prismatic structure; soft, very friable, slightly sticky and slightly plastic; few very fine roots; strong effervescence; moderately alkaline; gradual wavy boundary.

IICca—34 to 60 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; weak medium subangular blocky structure; slightly hard, friable, sticky and plastic; many soft masses of carbonates; violent effervescence; moderately alkaline.

The mollic epipedon is 7 to 16 inches thick.

The A horizon has color value of 4 or 5 and chroma of 2 or 3. It has value of 2 or 3 if the soil is moist. It typically is silt loam, but in some pedons it is light silty clay loam or loam. The B2 horizon has color value of 4 through 6 and chroma of 2 through 4. It has value of 3 or 4 if the soil is moist. It typically is silt loam, but in some pedons it is light silty clay loam. The IICca horizon has hue of 2.5Y or 5Y, value of 5 through 7, and chroma of 2 through 4. Value is 4 through 6 if the soil is moist. The IICca horizon is clay loam or heavy loam.

Tonka series

The Tonka series consists of deep, poorly drained soils that are slowly permeable. These soils are on uplands. They formed in local alluvium over till. Tonka soils are commonly ponded during spring runoff or following heavy rains. Slope is 0 to 1 percent.

Tonka soils are similar to Dimmick soils and are commonly adjacent to Arnegard, Flaxton, and Williams soils on the landscape. Dimmick soils do not have an albic horizon. The Dimmick soils and the Tonka soils are in similar positions on the landscape. Arnegard soils are well drained, have a mollic epipedon more than 16 inches thick, and are in concave swales along drainageways. Flaxton and Williams soils do not have an albic horizon and are on higher parts of well drained uplands.

Typical pedon of Tonka silt loam, 540 feet south and 500 feet west of the northeast corner of sec. 33, T. 146 N., R. 94 W.

A1—0 to 8 inches; dark gray (10YR 4/1) silt loam, black (10YR 2/1) moist; moderate medium granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; slightly acid; abrupt wavy boundary.

A2—8 to 13 inches; light brownish gray (10YR 6/2) loam, very dark gray (10YR 3/1) moist; common medium distinct dark yellowish brown (10YR 3/4) mottles; moderate thin platy structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine roots; slightly acid; abrupt irregular boundary.

B21t—13 to 23 inches; dark gray (10YR 4/1) silty clay, very dark gray (10YR 3/1) moist; strong coarse prismatic structure parting to moderate medium angular blocky; very hard, very firm, very sticky and very plastic; few very fine roots; slightly acid; gradual wavy boundary.

B22t—23 to 29 inches; gray (10YR 5/1) silty clay, dark gray (10YR 4/1) moist; strong coarse prismatic structure parting to moderate fine angular blocky; very hard, very firm, very sticky and very plastic; few very fine roots; slightly acid; gradual wavy boundary.

B3—29 to 36 inches; grayish brown (2.5Y 5/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; many medium faint light brownish gray (2.5Y 6/2) mottles; weak coarse prismatic structure parting to moderate medium subangular blocky; hard, firm, sticky and plastic; few very fine roots; slightly acid; gradual wavy boundary.

C1—36 to 47 inches; light gray (5Y 7/2) clay loam, light olive gray (5Y 6/2) moist; common fine distinct light yellowish brown (2.5Y 6/4) mottles; weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; mildly alkaline; gradual wavy boundary.

C2ca—47 to 60 inches; light gray (5Y 7/2) clay loam, pale olive (5Y 6/3) moist; weak medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common fine threads of carbonates; violent effervescence; moderately alkaline.

Some pedons are noncalcareous to a depth of 60 inches.

The A1 horizon has color value of 3 or 4. Value is 2 or 3 if the soil is moist. The A1 horizon typically is silt loam, but in some pedons it is loam or silty clay loam. The A2 horizon has hue of 10YR or 2.5Y and value of 5 through 7. It has value of 3 through 5 if the soil is moist. It typically is loam, but in some pedons it is silt loam. The B2t horizon has hue of 10YR, 2.5Y, or 5Y; value of 4 or 5; and chroma of 1 or 2. Value is 2 through 4 if the soil is moist. The B2t horizon typically is silty clay, but in some pedons it is silty clay loam or clay loam.

Trembles Variant

The Trembles Variant consists of deep, poorly drained soils that are moderately rapidly permeable. These soils are on flood plains. They formed in recent, stratified alluvium. Slope is 0 to 1 percent.

The Trembles Variant is commonly adjacent to Banks, Cabba, and Havrelon soils on the landscape. Havrelon soils are well drained and are on slightly higher positions on flood plains. Cabba soils, on nearby slopes, are shallow to soft bedrock. Banks soils are sandy and are near the stream channel.

Typical pedon of Trembles Variant fine sandy loam, 850 feet west and 1,900 feet north of the southeast corner of sec. 34, T. 148 N., R. 95 W.

A1—0 to 12 inches; light brownish gray (2.5Y 6/2) fine sandy loam, grayish brown (2.5Y 5/2) moist; weak thin platy structure; soft, very friable, slightly sticky and slightly plastic; few very fine and fine roots; strong effervescence; moderately alkaline; abrupt smooth boundary.

C1—12 to 23 inches; light brownish gray (2.5Y 6/2) fine sandy loam, grayish brown (2.5Y 5/2) moist; common medium prominent strong brown (7.5YR 5/6) mottles; weak thin platy structure; soft, very friable, slightly sticky and slightly plastic; few fine and medium roots; strong effervescence; moderately alkaline; abrupt smooth boundary.

C2—23 to 29 inches; light brownish gray (2.5Y 6/2) fine sandy loam, grayish brown (2.5Y 5/2) moist; common medium prominent strong brown (7.5YR 5/6) mottles; weak thin platy structure; soft, very friable, slightly sticky and slightly plastic; common fine roots; strong effervescence; moderately alkaline; abrupt smooth boundary.

C3—29 to 31 inches; grayish brown (2.5Y 5/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; common medium prominent brown (7.5YR 5/4) mottles; weak thin platy structure; soft, very friable, slightly sticky and slightly plastic; common very fine, fine and medium roots; strong effervescence; moderately alkaline; abrupt smooth boundary.

C4—31 to 60 inches; light brownish gray (2.5Y 6/2) fine sandy loam, grayish brown (2.5Y 5/2) moist; common medium prominent brown (7.5YR 5/4) mottles; moderate thin platy structure; slightly hard, very friable, slightly sticky and nonplastic; common fine roots; strong effervescence; moderately alkaline.

The A horizon has hue of 2.5Y or 10YR, value of 5 or 6, and chroma of 2 or 3. It has value of 4 or 6 if the soil is moist. It is fine sandy loam, sandy loam, or loam. The C horizon has hue of 5Y, 2.5Y, or 10YR. It is fine sandy loam, sandy loam, or loam. Thin strata of loam or loamy fine sand are common in some pedons.

Vanda series

The Vanda series consists of deep, well drained soils that are very slowly permeable. These soils are on fans and terraces. They formed in clayey alluvium from eroding Badland. Slope ranges from 1 to 9 percent.

Vanda soils are commonly adjacent to Cherry and Havrelon soils on the landscape. Cherry and Havrelon soils have less clay and do not have salts in lower horizons. They and the Vanda soils are in similar positions on the landscape.

Typical pedon of Vanda silty clay, 1 to 3 percent slopes, 1,620 feet south and 1,120 feet west of the northeast corner of sec. 5, T. 147 N., R. 93 W.

A2—0 to 2 inches; light olive gray (5Y 6/2) silty clay, olive gray (5Y 4/2) moist; weak fine granular structure; hard, very friable, slightly sticky and slightly plastic; common very fine and fine roots;

slight effervescence; strongly alkaline; abrupt smooth boundary.

C1—2 to 5 inches; olive gray (5Y 5/2) silty clay, olive gray (5Y 4/2) moist; weak medium subangular blocky structure; very hard, firm, sticky and plastic; common very fine and fine roots; slight effervescence; strongly alkaline; abrupt smooth boundary.

C2cs—5 to 21 inches; light olive gray (5Y 6/2) silty clay, olive gray (5Y 4/2) moist; weak medium subangular blocky structure; extremely hard, firm, sticky and plastic; few very fine roots; common fine masses of salt and gypsum crystals; slight effervescence; strongly alkaline; clear wavy boundary.

C3—21 to 33 inches; light olive gray (5Y 6/2) silty clay, olive gray (5Y 5/2) moist; moderate thick platy structure parting to weak medium subangular blocky; hard, friable, slightly sticky and slightly plastic; strong effervescence; strongly alkaline; gradual wavy boundary.

C4sa—33 to 45 inches; olive gray (5Y 5/2) silty clay, olive gray (5Y 4/2) moist; weak medium and fine subangular blocky structure; extremely hard, firm, very sticky and very plastic; common fine masses of carbonates; few very fine salt crystals; slight effervescence; strongly alkaline; gradual wavy boundary.

C5—45 to 60 inches; olive (5Y 5/3) silty clay, olive gray (5Y 4/2) moist; massive; extremely hard, firm, very sticky and very plastic; slight effervescence; strongly alkaline.

Salt crystals range in depth from 5 to 20 inches. The 10- to 40-inch control section is heavy silty clay loam or silty clay and averages more than 35 percent clay.

The A horizon has hue of 2.5Y or 5Y, value of 5 through 7, and chroma of 1 through 3. Value is 4 or 5 if the soil is moist. The C horizon has hue of 2.5Y or 5Y and chroma of 2 or 3.

Vebar series

The Vebar series consists of moderately deep, well drained soils that are moderately rapidly permeable. These soils are on uplands. They formed in residuum weathered from soft, calcareous sandstone. Slope ranges from 1 to 25 percent.

Vebar soils are similar to Parshall soils and are commonly adjacent to Amor, Cohagen, Lihen, and Parshall soils on the landscape. Parshall soils have a mollic epipedon more than 16 inches thick and are on outwash plains and in upland swales. Amor soils have less sand than Vebar soils. The Amor soils and the Vebar soils are in similar positions on the landscape. Cohagen soils do not have a mollic epipedon, have paralithic contact at a depth of less than 20 inches, and are on steep hilltops and ridges. Lihen soils are sandy and are on terraces and nearby uplands.

Typical pedon of Vebar fine sandy loam, 9 to 15 percent slopes, native grass, 1,530 feet south and 1,135 feet east of the northwest corner of sec. 19, T. 145 N., R. 93 W.

A1—0 to 8 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine and medium granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; about 1 percent pebbles; slightly acid; clear wavy boundary.

B21—8 to 14 inches; brown (10YR 5/3) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; many very fine roots; about 1 percent pebbles; neutral; clear wavy boundary.

B22—14 to 23 inches; pale brown (10YR 6/3) fine sandy loam, dark brown (10YR 4/3) moist; weak coarse prismatic structure parting to weak medium subangular blocky; slightly hard, very friable, nonsticky and nonplastic; common very fine roots; about 1 percent pebbles; krotovina about 2 1/2 inches in diameter; neutral; abrupt wavy boundary.

Cca—23 to 38 inches; light gray (2.5Y 7/2) very fine sandy loam, grayish brown (2.5Y 5/2) moist; massive; slightly hard, very friable, nonsticky and nonplastic; few very fine roots; krotovina about 3 inches in diameter; few fine masses of carbonates; violent effervescence; moderately alkaline; abrupt irregular boundary.

Cr—38 to 60 inches; light gray (2.5Y 7/2) soft sandstone, grayish brown (2.5Y 5/2) moist; few very fine roots; moderately alkaline.

The solum typically is about 23 inches thick but ranges from 15 to 40 inches in thickness. Soft sandstone ranges in depth from 20 to 40 inches. The mollic epipedon is 7 to 16 inches thick.

The A horizon has color value of 3 or 4 and chroma of 2 or 3. It has value of 2 or 3 if the soil is moist. It is fine sandy loam, very fine sandy loam, or sandy loam. The B2 horizon has hue of 10YR or 2.5Y, value of 4 through 6, and chroma of 2 through 4. It has value of 3 or 4 if the soil is moist. It is fine sandy loam, very fine sandy loam, or sandy loam. The C horizon has hue of 2.5Y or 5Y, value of 5 through 7, and chroma of 2 through 4. Value is 4 through 6 if the soil is moist. The C horizon is very fine sandy loam or fine sandy loam. The soft sandstone bedrock crushes to fine sandy loam, loamy very fine sand, or loamy fine sand. Some areas have thin ledges or concretion pipes of hard sandstone.

Velva series

The Velva series consists of deep, well drained soils that are moderately rapidly permeable. These soils are

on flood plains and terraces. They are occasionally flooded for brief periods. They formed in recent, stratified alluvium. Slope ranges from 1 to 3 percent.

Velva soils are similar to Parshall soils and are commonly adjacent to Straw soils on the landscape. Parshall soils decrease regularly in organic matter with depth. They are on uplands. Straw soils have more clay than Velva soils and are on flood plains and terraces.

Typical pedon of Velva fine sandy loam, 1 to 3 percent slopes, 1,200 feet south and 150 feet east of the northwest corner of sec. 33, T. 144 N., R. 96 W.

Ap—0 to 11 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; common fine and very fine roots; neutral; abrupt smooth boundary.

C1—11 to 14 inches; grayish brown (2.5Y 5/2) loamy fine sand, dark grayish brown (2.5Y 4/2) moist; single grain; loose, nonsticky and nonplastic; few very fine roots; neutral; abrupt smooth boundary.

Ab—14 to 16 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; few very fine roots; neutral; abrupt smooth boundary.

C2—16 to 23 inches; grayish brown (2.5Y 5/2) fine sandy loam, very dark grayish brown (2.5Y 3/2) moist; weak coarse prismatic structure parting to weak coarse and medium subangular blocky; loose, nonsticky and nonplastic; few very fine roots; strong effervescence; mildly alkaline; clear smooth boundary.

C3—23 to 26 inches; grayish brown (2.5Y 5/2) loamy sand, dark grayish brown (2.5Y 4/2) moist; single grain; loose, nonsticky and nonplastic; few very fine roots; strong effervescence; mildly alkaline; clear smooth boundary.

C4—26 to 60 inches; light brownish gray (2.5Y 6/2) stratified loam, fine sandy loam and loamy fine sand, dark grayish brown (2.5Y 4/2) moist; massive; soft, very friable, nonsticky and nonplastic; few very fine roots; strong effervescence; moderately alkaline.

The A horizon has hue of 10YR or 2.5Y, value of 3 through 5, and chroma of 2 or 3. It has value of 2 or 3 if the soil is moist. It typically is fine sandy loam, but in some pedons it is loam, clay loam, or very fine sandy loam. The C horizon has hue of 2.5Y or 10YR, value of 4 through 7, and chroma of 2 through 4. Value is 3 through 5 if the soil is moist.

Wabek series

The Wabek series consists of excessively drained, very rapidly permeable soils on outwash plains and terraces. They are shallow or very shallow over sand and gravel. These soils formed in loamy sediment over sand and gravelly alluvium. Slope ranges from 1 to 15 percent.

Wabek soils are similar to Baahish soils and are commonly adjacent to Bowdle and Shambo soils on the landscape. Baahish soils are shallow to gravelly limestone and have a B horizon. Bowdle soils are 20 to 40 inches deep to gravel. Ruso soils are 20 to 40 inches deep to sand and gravel. Shambo soils do not have gravel within 40 inches of the surface. The Baahish, Bowdle, Ruso, and Shambo soils and the Wabek soils are in similar positions on the landscape.

Typical pedon of Wabek gravelly loam, 1 to 15 percent slopes, in grassland, 200 feet east and 2,065 feet south of the northwest corner of sec. 26, T. 142 N., R. 94 W.

A1—0 to 6 inches; dark grayish brown (10YR 4/2) gravelly loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to weak fine granular; slightly hard, friable, slightly sticky and slightly plastic; many fine and medium roots; neutral; clear smooth boundary.

C1ca—6 to 11 inches; light brownish gray (10YR 6/2) gravelly sandy loam, dark grayish brown (10YR 4/2) moist; weak medium blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few fine and medium roots; disseminated carbonates throughout; violent effervescence; mildly alkaline; gradual wavy boundary.

IIC2—11 to 60 inches; yellowish brown (10YR 5/4) stratified very gravelly loamy sand and coarse sand, dark brown (10YR 4/3) moist; single grain; loose, nonsticky and nonplastic; thin crusts of carbonates on underside of pebbles; about 55 percent pebbles; some strata of loam and sandy loam less than 4 inches thick; slight effervescence; mildly alkaline.

Sand and gravel range in depth from 7 to 14 inches.

The A horizon has color value of 4 or 5. Value is 2 or 3 if the soil is moist. The A horizon is loam, gravelly loam, or sandy loam.

Watrous series

The Watrous series consists of moderately deep, well drained soils that are moderately permeable. These soils are on uplands. They formed in residuum from hard sandstone bedrock. Slope ranges from 1 to 6 percent.

Watrous soils are similar to Amor and Morton soils and are commonly adjacent to Cabba, Sen, and Vebar soils on the landscape. Amor soils do not have an argillic horizon. Morton and Sen soils have more silt than Watrous soils. Cabba soils do not have a mollic epipedon and are on crests of steep hills and on side slopes. Vebar soils contain more sand and less clay than Watrous soils. Amor, Morton, Sen, and Vebar soils do not have the hard bedrock that the Watrous soils have. They are on upland plains.

Typical pedon of Watrous loam, 1 to 6 percent slopes, 1,100 feet north and 1,800 feet east of the southwest corner of sec. 6, T. 143 N., R. 93 W.

Ap—0 to 5 inches; dark grayish brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; moderate medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; common very fine roots; neutral; abrupt smooth boundary.

A12—5 to 7 inches; dark brown (10YR 4/3) loam, very dark grayish brown (10YR 3/2) moist; weak coarse prismatic structure parting to moderate medium platy; hard, friable, slightly sticky and slightly plastic; common very fine roots; neutral; clear wavy boundary.

B21t—7 to 16 inches; brown (10YR 5/3) clay loam, dark brown (10YR 3/3) moist; moderate coarse prismatic structure parting to weak medium and coarse angular blocky; hard, firm, sticky and slightly plastic; few very fine roots; neutral; gradual wavy boundary.

B22t—16 to 24 inches; grayish brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) moist; moderate coarse prismatic structure parting to weak medium and coarse angular blocky; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; slight effervescence; mildly alkaline; gradual wavy boundary.

Cca—24 to 27 inches; light gray (2.5Y 7/2) loam, light olive brown (2.5Y 5/4) moist; weak medium prismatic structure parting to weak medium subangular blocky; slightly hard, very friable, slightly sticky and slightly plastic; few very fine roots; many fine soft masses of carbonates; violent effervescence; mildly alkaline; abrupt wavy boundary.

R—27 to 60 inches; pale yellow (2.5Y 7/2) hard sandstone.

The thickness of the solum and the depth to hard sandstone range from 20 to 40 inches. The mollic epipedon is 7 to 16 inches thick.

The A horizon has color value of 4 or 5. Value is 2 or 3 if the soil is moist. The A horizon typically is loam, but in some pedons it is silt loam or light clay loam. The B2t horizon has color value of 4 through 6 and chroma of 2 through 4. Value is 3 or 4 if the soil is moist. The bedrock typically is cemented, calcareous sandstone, but some is limestone or hard shale.

Wayden series

The Wayden series consists of shallow, well drained soils that are slowly permeable. These soils are on uplands. They formed in soft, clayey shale and claystone bedrock. Slope ranges from 9 to 25 percent.

Wayden soils are similar to Cabba soils and are commonly adjacent to Cabba, Moreau, and Rhoades soils on the landscape. Cabba soils are fine loamy. The Cabba and the Wayden soils are in similar positions on the landscape. Moreau soils have soft bedrock at a depth of 20 to 40 inches. Rhoades soils have a natric horizon and soft bedrock at a depth of more than 40 inches. Moreau and Rhoades soils are on nearby, lower parts of side slopes and foot slopes.

Typical pedon of Wayden silty clay, 9 to 25 percent slopes, 735 feet south and 2,620 feet east of the northwest corner of sec. 15, T. 142 N., R. 94 W.

A1—0 to 4 inches; grayish brown (2.5Y 5/2) silty clay, very dark grayish brown (2.5Y 3/2) moist; weak very coarse granular structure; slightly hard, friable, sticky and plastic; common medium and fine roots; slight effervescence; mildly alkaline; gradual smooth boundary.

C—4 to 16 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; strong medium subangular blocky structure; very hard, firm, sticky and plastic; few fine roots; many small soft masses of segregated carbonates; strong effervescence; moderately alkaline; clear wavy boundary.

Cr1—16 to 36 inches; light olive gray (5Y 6/2) soft platy shale, olive (5Y 5/3) moist; slight effervescence; mildly alkaline; clear wavy boundary.

Cr2—36 to 60 inches; gray (5Y 6/1) stratified soft siltstone, olive gray (5Y 5/2) moist; slight effervescence; mildly alkaline.

Soft siltstone or shale range in depth from 10 to 20 inches. The A and C horizons that are over the soft bedrock typically are silty clay, but in some pedons they are silty clay loam, clay loam, or clay.

Williams series

The Williams series consists of deep, moderately slowly permeable soils that are well drained. These soils are on uplands. They formed in loam or clay loam till. Slope ranges from 1 to 25 percent.

Williams soils are similar to Farland, Morton, and Temvik soils and are commonly adjacent to Arnegard, Flaxton, Noonan, Temvik, and Tonka soils on the landscape. Farland, Morton, and Temvik soils have more silt than Williams soils. Flaxton soils are pachic and have a surface layer of fine sandy loam. The Flaxton, Morton, and Temvik soils and the Williams soils are in similar positions on the landscape. Arnegard soils do not have an argillic horizon and are pachic. Arnegard and Farland soils and are in shallow swales and depressions. Noonan soils have a natric horizon and are in slightly concave depressions on uplands. Tonka soils are poorly drained and are in nearby shallow basins.

Typical pedon of Williams loam, 1 to 3 percent slopes, 350 feet south and 1,570 feet east of the northwest corner of sec. 33, T. 145 N., R. 92 W.

Ap—0 to 8 inches; dark grayish brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; 2 percent pebbles; neutral; abrupt smooth boundary.

B21t—8 to 16 inches; brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; strong medium prismatic structure parting to strong medium angular blocky; hard, firm, sticky and plastic; few very fine roots; many thin dark brown (10YR 3/3) clay films on faces of peds; neutral; clear wavy boundary.

B22t—16 to 23 inches; light brownish gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; strong medium prismatic structure parting to strong medium angular blocky; hard, firm, sticky and plastic; few very fine roots; many thin clay films on faces of peds; 2 percent pebbles; mildly alkaline; clear wavy boundary.

C1ca—23 to 39 inches; light gray (2.5Y 7/2) clay loam, grayish brown (2.5Y 5/2) moist; few medium prominent olive (5Y 4/4) weathered coarse fragments; weak coarse subangular blocky structure; hard, friable, sticky and plastic; few very fine roots; 2 percent pebbles; common medium irregularly shaped soft masses of carbonates; violent effervescence; moderately alkaline; gradual wavy boundary.

C2—39 to 60 inches; light gray (2.5Y 7/2) clay loam, grayish brown (2.5Y 5/2) moist; weak medium subangular blocky structure; hard, firm, sticky and plastic; 2 percent pebbles; few medium irregularly shaped soft masses of carbonates; strong effervescence; moderately alkaline.

Carbonates range in depth from 10 to 30 inches. This soil typically is 1 to 10 percent, by volume, pebbles, cobbles, and stones and a few boulders.

The Ap horizon has color value of 4 or 5. Value is 2 or 3 if the soil is moist. The B2 horizon has color value of 4 through 6. It has value of 3 through 5 if the soil is moist.

Zahl series

The Zahl series consists of deep, well drained soils that are moderately slowly permeable. These soils are on uplands. They formed in calcareous till. Slope ranges from 6 to 25 percent.

Zahl soils are similar to Cabba soils and are commonly adjacent to Flaxton and Williams soils on the landscape. Cabba soils formed in residuum weathered from soft siltstone. The Cabba soils and the Zahl soils are in similar positions on the landscape. Flaxton and Williams soils have an argillic horizon and are on adjacent side slopes.

Typical pedon of Zahl loam in an area of Zahl-Williams loams, 15 to 25 percent slopes, 60 feet south and 180 feet west of the northeast corner of sec. 23, T. 145 N., R. 91 W.

A1—0 to 5 inches; dark grayish brown (2.5Y 4/2) loam, very dark grayish brown (2.5Y 3/2) moist; weak coarse prismatic structure parting to weak medium subangular blocky; hard, friable, slightly sticky and slightly plastic; common fine roots; neutral; gradual irregular boundary.

C1ca—5 to 28 inches; pale olive (5Y 6/3) clay loam, olive (5Y 5/3) moist; moderate coarse prismatic structure parting to moderate medium and fine subangular blocky; hard, friable, sticky and plastic; few fine roots; few small stones; many soft masses of carbonates; violent effervescence; moderately alkaline; gradual wavy boundary.

C2—28 to 60 inches; pale olive (5Y 6/3) clay loam, olive (5Y 5/3) moist; moderate medium and fine subangular blocky structure; hard, friable, sticky and plastic; few fine roots; few small stones; strong effervescence; moderately alkaline.

The A horizon has hue of 10YR or 2.5Y and value of 3 through 5. It has value of 2 or 3 if the soil is moist. It is loam or clay loam. The C horizon has hue of 2.5Y or 5Y, value of 5 through 7, and chroma of 2 through 4. Value is 4 through 6 if the soil is moist.

formation of the soils

Soil forms through the physical and chemical weathering of deposited or accumulated geologic material. Soil characteristics are determined by (1) the physical traits and chemical and mineralogical composition of the parent material; (2) the climate under which the soil formed and has existed during formation; (3) the plant and animal life on and in the soil; (4) the relief, and (5) the length of time that the processes of soil formation have acted on the soil material.

Climate and plant and animal life, mainly plants, are very influential factors of soil formation. They determine the nature of weathering and slowly change the parent material into a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by the relief and the parent material. Finally, time is needed in order for the climatic and biological forces to weather the parent material and form a soil. Usually, a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. Many processes of soil formation are still unknown.

parent material

Texture is one of the most important physical properties of the parent material because it determines the texture of most soils. Other properties of the parent material can also be important; for example, soils that contain excess sodium salts generally formed in parent material that also contains excess sodium salts.

The parent material of soils in Dunn County has several different origins. The most extensive parent material is material weathered from soft residual bedrock of the Tertiary Period. The exposed bedrock in Dunn County is referred to as continental sediment, meaning that the sediment was deposited on the land by running water of streams and rivers and by wind. The deeper sediment, such as that that provides the source of water for artesian wells, is marine sediment originally deposited in shallow saltwater seas. The three formations of this period are the White River Formation (Oligocene Period), the Golden Valley Formation (Eocene Period), and the Fort Union Formation (Paleocene Period).

White River, the upper member of the three formations, is the youngest residual deposit in the county and state. In Dunn County, the Killdeer Mountains are capped with this formation and for several miles around the outwash material is from this formation. It includes siltstone, limestone, silt, and sand. Baahish and Hidatsa soils are examples of soils that formed in this outwash sediment. The outwash sediments consist mainly of limestone cobbles and surrounds the Killdeer Mountains.

The Golden Valley Formation covers scattered areas of the county and is under the younger White River Formation in the Killdeer Mountains area. The Golden Valley Formation consists of clay, shale, and sand and some lignite coal fragments. It is generally high in kaolinitic clay. The light gray bedrock stained yellow and orange in places is referred to as the Orange Marker Beds. Lefor soils are an example of soils that formed in this sediment.

Fort Union is the oldest geological formation to crop out in the survey area. It is comprised of the upper Sentinel Butte member and the lower Tongue River member. The Sentinel Butte member is more extensive. These two members consist of silt, clay, sand, lignite, petrified wood, and scoria (porcelanite), and deposits include soft bedrock, shale, sandstone, and extremely hard rock. The parent material of Morton, Regent, Amor, Cabba, Vebar (fig. 15), and Cohagen soils is of the Fort Union Formation.

Figure 15.—Profile of Vebar soils, which formed in the soft bedrock of the Fort Union Formation.

Glacial sediment is another type of continental sediment that was deposited in a variety of ways, but mainly, directly or indirectly, by glaciation. Glaciers covered all of Dunn County except the southwestern part, but only a few areas of glacial deposits remain that are thick enough for soil formation. Erosion has removed much of the till material and has left the glacial boulders over all but the western and northern parts of Dunn County. Williams, Noonan, and Zahl soils are examples of soils that formed in material deposited directly from glacial ice. Tonka soils are examples of soils that formed in material deposited in swales and depressions created by glaciers. Farland, Shambo, Bowdle, and Ruso soils are examples of soils that formed in material deposited by water flowing from glaciers. Deposits of sandy and silty windblown sediment over till are the parent materials of the Flaxton and Temvik soils.

The parent material of the soils on flood plains and terraces is alluvium deposited by the flood water of streams. These soils are stratified and subject to flooding. Some have an old, buried surface layer. Banks and Havrelon soils, along the Little Missouri River, and Straw and Velva soils, along the Knife and Green Rivers and along some of the larger creeks, are examples of soils that formed in alluvium.

In a few areas the soils formed in material weathered from porcelanite, or scoria. Porcelanite was formed by the burning lignite coal veins in the Fort Union and Golden Valley Formations. The reddish porcelanite, a natural brick, formed when the heat from the burning lignite coal baked the adjacent sediment. Searing and Brandenburg soils formed in material weathered from porcelanite.

Soils that formed in local alluvial sediment on residual uplands are Savage, Grail, and Lawther soils. Salts, particularly sodium, in the parent material contributed to the formation of the Harriet, Rhoades, and Daglum soils. Cherry soils formed in colluvial sediment that eroded from exposed bedrock in the Badland.

climate

Climate is perhaps the most influential factor in soil formation. The physical and chemical processes of soil weathering from the parent material, as well as biological activities in the soil, are influenced by climate. The processes of soil formation are most active if the climate is warm and moist. Climate influences these processes to a large extent by the effect it has on vegetation.

Dunn County has a continental, semiarid climate characterized by long, cold winters and short, warm summers. Most of the precipitation falls during the growing season. This type of climate favors the growth of mid and short grasses.

Moisture and temperature directly affect the weathering processes in the parent material. They also affect the leaching and redistribution of carbonates and clay particles and the accumulation of organic matter in the soil profile. Freezing and thawing help break down soil particles in the parent material, thereby providing more surface area for chemical processes. The cold and semiarid climate prevent deep leaching and extensive chemical weathering. In this survey area, climate prevents large yields of vegetation, but it allows a slow rate of plant decay. This enables organic matter to accumulate in the soil.

plant and animal life

Plants have significantly influenced the formation of soils in Dunn County. Earthworms, small animals, and micro-organisms are also important but to a lesser extent.

The native vegetation consisted mostly of mid and short grasses. Plant roots act, both physically and chemically, as agents in weathering the parent material. Animal life and micro-organisms break down the dead plant tissues into humus, thus releasing nutrients for plants. The plant roots also provide a medium whereby nutrients that have been leached into the lower part of the soil are brought back to the surface.

relief

Relief, or the lay of the land, influences soil formation mainly by controlling the movement of water. The effects of relief are modified by the other four factors of soil formation, especially climate and vegetation.

The profile of soils formed in depressions differs from that of soils formed in steep areas. The Tonka soils, in depressions, exhibit an advanced degree of horizonation because of the alternate wetting and drying cycle that occurs in the depression. The steep sloping Cabba soils exhibit a minimal degree of horizonation. Soils having gentle slopes generally support a more luxuriant plant cover than steeper soils. The steeper Cohagen and Brandenburg soils in this survey area generally have sparse vegetation, have lime close to the surface, and are low in content of organic matter. They have minimally developed profiles when compared to soils that have gentle slopes, such as Williams and Grail soils.

time

The formation of a soil is a very slow process. Much time is required for the processes of soil formation to act on the parent material and to form distinct horizons within the soil profile.

More time has been available for the formation of Williams soils on glacial till plains than for the formation of Havrelon soils on flood plains along the Little Missouri River. The forces of soil formation have been continually

acting on the parent material of Williams soils; however, Havrelon soils are frequently flooded and receive new material during each flood. As a result, Williams soils have well defined horizons and a high content of organic matter, and Havrelon soils do not have distinct horizons and have a low content of organic matter.

references

(1) American Association of State Highway [and Transportation] Officials. 1970. Standard specifications for highway materials and methods of sampling and testing. Ed. I0, 2 vol., illus.

(2) American Society for Testing and Materials. 1974. Method for classification of soils for engineering purposes. ASTM Stand. D 2487-69. *In* 1974 Annual Book of ASTM Standards, Part 19, 464 pp., illus.

(3) Carlson, Clarence G. 1969. Generalized glacial map of North Dakota. Miscellaneous Map Number 10. North Dakota Geological Survey.

(4) Klausing, Robert L. 1979. Ground-water resources of Dunn County, North Dakota. U.S. Geol. Surv., North Dakota Geol. Surv., North Dakota Water Comm., and Dunn County Water Manag. Board. Bull. 68: Part III; pp 1-48.

(5) Stenerson, Orville. January 1966. A history of Dunn County. University of North Dakota. 265 pp.

(6) United States Department of Agriculture. 1910. Soil survey of western North Dakota. Bureau of Soils. Government Printing Office. 80 pp.

(7) United States Department of Agriculture. 1951. Soil survey manual. U.S. Dep. Agric. Handb. 18, 503 pp., illus. [Supplements replacing pp. 173-188 issued May 1962]

(8) United States Department of Agriculture. 1975. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. Soil Conserv. Serv., U.S. Dep. Agric. Handb. 436, 754 pp., illus.

glossary

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Badland. Steep or very steep, commonly nonstony, barren land dissected by many intermittent drainage channels. Badland is most common in semiarid and arid regions where streams are entrenched in soft geologic material. Local relief generally ranges from 25 to 500 feet. Runoff potential is very high, and geologic erosion is active.

Basal till. Compact glacial till deposited beneath the ice.

Bench terrace. A raised, level or nearly level strip of earth constructed on or nearly on the contour, supported by a barrier of rocks or similar material, and designed to make the soil suitable for tillage and to prevent accelerated erosion.

Blowout. A shallow depression from which all or most of the soil material has been removed by wind. A blowout has a flat or irregular floor formed by a resistant layer or by an accumulation of pebbles or cobbles. In some blowouts the water table is exposed.

Bottom land. The normal flood plain of a stream, subject to flooding.

Boulders. Rock fragments larger than 2 feet (60 centimeters) in diameter.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity, but is more precise in meaning.

Channery soil. A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a fragment.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15.2 to 38.1 centimeters (6 to 15 inches) long.

Coarse textured soil. Sand or loamy sand.

Cobblestone (or cobble). A rounded or partly rounded fragment of rock 3 to 10 inches (7.5 to 25 centimeters) in diameter.

Colluvium. Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Compressible (in tables). Excessive decrease in volume of soft soil under load.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the

surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the removal of water from the soil. Drainage classes are determined on the basis of an overall evaluation of water removal as influenced by climate, slope, and position on the landscape. Precipitation, runoff, amount of moisture infiltrating the soil, and rate of water movement through the soil affect the degree and duration of wetness. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. The soils in this class generally are free of mottles throughout. They commonly are shallow, very porous, or steep, or a combination of these.

Somewhat excessively drained.—Water is removed from the soil rapidly. The soils in this class generally are free of mottles throughout. They commonly are shallow or moderately deep, very porous, or steep, or a combination of these.

Well drained.—Water is removed from the soil so readily that the upper 40 inches generally does not have the mottles or dull colors related to wetness.

Moderately well drained.—Water is removed from the soil so slowly that the upper 20 to 40 inches has the mottles or dull colors related to wetness. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Somewhat poorly drained.—Water is removed from the soil so slowly that the upper 10 to 20 inches has the mottles or dull colors related to wetness. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Poorly drained.—Water is removed so slowly that either the soil is periodically saturated or the upper 10 inches has the mottles or dull colors related to wetness. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water is at or on the surface most of the time. The soils in this class commonly have a slowly permeable layer, have a water table, or receive runoff or seepage, or they are characterized by a combination of these.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess alkali (in tables). Excess exchangeable sodium in the soil. The resulting poor physical properties restrict the growth of plants.

Excess fines (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Fine textured soil. Sandy clay, silty clay, and clay.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Frost action (in tables). Freezing and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

Glacial outwash (geology). Gravel, sand, and silt, commonly stratified, deposited by glacial melt water.

Glacial till (geology). Unsorted, nonstratified glacial drift consisting of clay, silt, sand, and boulders transported and deposited by glacial ice.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Green manure crop (agronomy). A soil-improving crop grown to be plowed under in an early stage of maturity or soon after maturity.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an upper case letter represents the major horizons. Numbers or lower case letters that follow represent subdivisions of the major horizons. An explanation of the subdivisions is given in the *Soil Survey Manual*. The major horizons of mineral soil are as follows:

O horizon.—An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Impervious soil. A soil through which water, air, or roots penetrate slowly or not at all. No soil is absolutely impervious to air and water all the time.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

Large stones (in tables). Rock fragments 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low strength. The soil is not strong enough to support loads.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Moderately coarse textured soil. Sandy loam and fine sandy loam.

Moderately fine textured soil. Clay loam, sandy clay loam, and silty clay loam.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Outwash, glacial. Stratified sand and gravel produced by glaciers and carried, sorted, and deposited by glacial melt water.

Outwash plain. A landform of mainly sandy or coarse textured material of glaciofluvial origin. An outwash plain is commonly smooth; where pitted, it is generally low in relief.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Percs slowly (in tables). The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.20 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Ponding. Standing water on soils in closed depressions. The water can be removed only by percolation or evapotranspiration.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Rippable. Bedrock or hardpan can be excavated using a single-tooth ripping attachment mounted on a tractor with a 200-300 draw bar horsepower rating.

Rooting depth (in tables). Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a

soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Slickspot. A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil is generally silty or clayey, is slippery when wet, and is low in productivity.

Slippage. Soil mass susceptible to movement downslope when loaded, excavated, or wet.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to insure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Sodic (alkali) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Sodicity. The degree to which a soil is affected by exchangeable sodium. Sodicity is expressed as a sodium absorption ratio (SAR) of a saturation extract, or the ratio of Na^+ to $Ca^{++} + Mg^{++}$. The degrees of sodicity are—

	SAR
Slight	less than 13:1
Moderate	13-30:1
Strong	more than 30:1

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stony. Refers to a soil containing stones in numbers that interfere with or prevent tillage.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the profile below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A1, A2, or A3) below the surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A horizon. Includes all subdivisions of this horizon (A1, A2, A3).

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Till plain. An extensive flat to undulating area underlain by glacial till.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Topsoil. The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter and is used to topdress roadbanks, lawns, and land affected by mining.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but occurring in such a limited geographic area that creation of a new series is not justified.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

[Recorded in the period 1951-76 at Dunn Center, North Dakota]

Month	Temperature: Average daily maximum	Temperature: Average daily minimum	Temperature: Average daily	Temperature: 2 years in 10 will have-- Maximum temperature higher than--	Temperature: 2 years in 10 will have-- Minimum temperature lower than--	Temperature: Average number of growing degree days[1]	Precipitation: Average	Precipitation: 2 years in 10 will have-- Less than--	Precipitation: 2 years in 10 will have-- More than--	Precipitation: Average number of days with 0.10 inch or more	Precipitation: Average snowfall
	°F	°F	°F	°F	°F	Units	In	In	In		In
January-----	19.4	-2.5	8.4	49	-34	0	.41	.16	.60	2	6.6
February----	26.5	3.9	15.2	53	-29	10	.46	.15	.70	2	5.9
March-------	34.6	12.3	23.5	68	-23	52	.63	.19	.97	2	6.6
April-------	51.4	28.1	39.9	80	6	117	1.70	.45	2.71	5	5.9
May---------	64.9	40.1	52.6	91	23	391	2.32	.75	3.55	6	.7
June--------	74.3	50.5	62.4	95	35	672	3.75	2.45	4.93	8	.1
July--------	82.6	55.2	68.9	100	41	896	2.23	1.08	3.16	6	.0
August------	82.5	53.3	68.0	102	38	868	2.02	.74	3.04	5	.0
September---	69.6	42.2	55.9	98	23	477	1.53	.48	2.36	4	.4
October-----	58.4	31.7	45.1	86	14	213	.83	.24	1.30	3	1.5
November----	38.8	17.3	28.1	70	-11	35	.48	.10	.77	2	4.4
December----	26.6	5.3	16.0	53	-29	17	.37	.14	.55	2	5.6
Yearly:											
Average--	52.5	28.3	40.3	---	---	---	---	---	---	---	---
Extreme--	---	---	---	102	-36	---	---	---	---	---	---
Total----	---	---	---	---	---	3,748	16.73	13.42	19.83	47	37.7

[1]A growing degree day is a unit of heat available for plant growth. It can be calculated by adding the maximum and minimum daily temperatures, dividing the sum by 2, and subtracting the temperature below which growth is minimal for the principal crops in the area (40° F).

TABLE 2.--FREEZE DATES IN SPRING AND FALL

[Recorded in the period 1951-76 at Dunn Center, North Dakota]

Probability	Temperature		
	24° F or lower	28° F or lower	32° F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	May 12	May 22	June 6
2 years in 10 later than--	May 7	May 17	May 31
5 years in 10 later than--	April 27	May 8	May 19
First freezing temperature in fall:			
1 year in 10 earlier than--	September 26	September 14	September 2
2 years in 10 earlier than--	October 1	September 20	September 7
5 years in 10 earlier than--	October 10	October 2	September 18

TABLE 3.--GROWING SEASON

[Recorded in the period 1951-76 at Dunn Center, North Dakota]

Probability	Daily minimum temperature during growing season		
	Higher than 24° F	Higher than 28° F	Higher than 32° F
	Days	Days	Days
9 years in 10	141	121	99
8 years in 10	149	130	106
5 years in 10	166	146	120
2 years in 10	182	162	135
1 year in 10	190	170	142

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
3	Straw loam, channeled	23,380	1.8
4	Arnegard loam, 1 to 3 percent slopes	11,195	0.8
4B	Arnegard loam, 3 to 6 percent slopes	7,900	0.6
5	Tonka silt loam	500	*
7	Straw-Rhoades loams	3,170	0.2
8C	Cabba-Chama silt loams, 6 to 9 percent slopes	24,380	1.8
9D	Amor-Cabba loams, 9 to 15 percent slopes	37,560	2.8
9E	Cabba loam, 15 to 45 percent slopes	90,235	6.8
10D	Cabba extremely stony loam, 3 to 25 percent slopes	3,415	0.3
11F	Cabba-Badland complex, 15 to 120 percent slopes	21,760	1.6
12	Banks loamy sand, 1 to 3 percent slopes	2,455	0.2
13D	Wabek gravelly loam, 1 to 15 percent slopes	4,090	0.3
15	Belfield-Farland silt loams, 1 to 3 percent slopes	5,985	0.4
16B	Belfield-Savage silty clay loams, 1 to 6 percent slopes	2,515	0.2
18	Belfield-Grail silty clay loams, 1 to 3 percent slopes	11,400	0.9
19B	Belfield-Morton silt loams, 1 to 6 percent slopes	9,525	0.7
21B	Cherry silty clay loam, 1 to 6 percent slopes	2,170	0.2
21C	Cherry silty clay loam, 6 to 9 percent slopes	2,670	0.2
22	Colvin silt loam, saline	1,160	0.1
24	Dimmick clay	2,185	0.2
25F	Baahish-Rock outcrop complex, 15 to 120 percent slopes	2,900	0.2
27	Farland silt loam, 1 to 3 percent slopes	7,960	0.6
27B	Farland silt loam, 3 to 6 percent slopes	4,700	0.4
29B	Farland-Rhoades silt loams, 1 to 6 percent slopes	13,440	1.0
30E	Cohagen-Vebar fine sandy loams, 9 to 25 percent slopes	73,385	5.5
31F	Cohagen-Vebar-Rock outcrop complex, 15 to 40 percent slopes	30,670	2.3
32B	Flaxton-Williams complex, 1 to 6 percent slopes	7,780	0.6
32C	Flaxton-Williams complex, 6 to 9 percent slopes	4,710	0.4
33	Grail silt loam, 1 to 3 percent slopes	6,490	0.5
33B	Grail silt loam, 3 to 6 percent slopes	4,340	0.3
35	Lawther silty clay, 1 to 3 percent slopes	5,615	0.4
35B	Lawther silty clay, 3 to 6 percent slopes	960	0.1
37	Trembles Variant fine sandy loam	2,250	0.2
39	Havrelon silt loam	2,870	0.2
40	Havrelon silt loam, channeled	3,015	0.2
41	Heil silty clay loam	1,845	0.1
42B	Lefor fine sandy loam, 1 to 6 percent slopes	4,240	0.3
42C	Lefor fine sandy loam, 6 to 9 percent slopes	2,795	0.2
43B	Havrelon silt loam, fan, 1 to 6 percent slopes	965	0.1
44B	Lihen loamy fine sand, 1 to 6 percent slopes	1,240	0.1
44D	Lihen loamy fine sand, 6 to 15 percent slopes	2,400	0.2
45B	Ruso sandy loam, 1 to 6 percent slopes	3,025	0.2
45C	Ruso sandy loam, 6 to 9 percent slopes	1,515	0.1
46	Bowdle loam, 1 to 3 percent slopes	3,315	0.2
46B	Bowdle loam, 3 to 6 percent slopes	3,515	0.3
47	Moreau silty clay, 1 to 3 percent slopes	2,195	0.2
47B	Moreau silty clay, 3 to 6 percent slopes	19,465	1.5
47C	Moreau silty clay, 6 to 9 percent slopes	8,990	0.7
48B	Temvik silt loam, 3 to 6 percent slopes	1,480	0.1
49	Morton silt loam, 1 to 3 percent slopes	1,380	0.1
49B	Morton silt loam, 3 to 6 percent slopes	18,465	1.4
49C	Morton silt loam, 6 to 9 percent slopes	7,235	0.5
51C	Amor extremely stony loam, 1 to 9 percent slopes	1,920	0.1
52B	Morton-Rhoades silt loams, 1 to 6 percent slopes	27,415	2.1
52C	Morton-Rhoades silt loams, 6 to 9 percent slopes	14,315	1.1
53B	Watrous loam, 1 to 6 percent slopes	320	*
54B	Parshall fine sandy loam, 1 to 6 percent slopes	8,375	0.6
55	Pits	490	*
58	Regent silty clay loam, 1 to 3 percent slopes	855	0.1
58B	Regent silty clay loam, 3 to 6 percent slopes	11,005	0.8
58C	Regent silty clay loam, 6 to 9 percent slopes	3,185	0.2
61B	Regent-Rhoades silty clay loams, 1 to 6 percent slopes	24,290	1.8
61C	Regent-Rhoades silty clay loams, 6 to 9 percent slopes	4,290	0.3
62B	Rhoades silt loam, 1 to 6 percent slopes	62,925	4.7
62D	Rhoades-Cabba loams, 9 to 15 percent slopes	13,405	1.0
64	Badland	6,265	0.5
67	Savage silty clay loam, 1 to 3 percent slopes	5,495	0.4
67B	Savage silty clay loam, 3 to 6 percent slopes	2,425	0.2
68	Vanda silty clay, 1 to 3 percent slopes	1,790	0.1
69B	Savage-Rhoades silty clay loams, 1 to 6 percent slopes	21,970	1.6

See footnote at end of table.

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS--Continued

Map symbol	Soil name	Acres	Percent
70C	Searing loam, 3 to 9 percent slopes	1,030	0.1
71B	Sen silt loam, 3 to 6 percent slopes	13,340	1.0
71C	Sen silt loam, 6 to 9 percent slopes	10,330	0.8
73C	Cherry-Vanda complex, 3 to 9 percent slopes, gullied	5,730	0.4
75	Straw loam	22,855	1.7
79	Velva fine sandy loam, 1 to 3 percent slopes	2,335	0.2
81B	Vebar-Parshall fine sandy loams, 1 to 6 percent slopes	40,370	3.0
81C	Vebar-Parshall fine sandy loams, 6 to 9 percent slopes	52,985	4.0
81D	Vebar fine sandy loam, 9 to 15 percent slopes	41,915	3.1
82D	Vebar extremely stony fine sandy loam, 3 to 15 percent slopes	3,235	0.2
83E	Baahish fine sandy loam, 9 to 50 percent slopes	7,475	0.6
84	Hidatsa loam, 1 to 3 percent slopes	4,155	0.3
84B	Hidatsa loam, 3 to 6 percent slopes	2,225	0.2
86F	Brandenburg-Cabba loams, 6 to 50 percent slopes	6,485	0.5
87F	Lakoa loam, 15 to 45 percent slopes	5,940	0.4
88	Williams loam, 1 to 3 percent slopes	5,550	0.4
88B	Williams loam, 3 to 6 percent slopes	28,015	2.1
88C	Williams loam, 6 to 9 percent slopes	13,600	1.0
90C	Williams extremely stony loam, 1 to 9 percent slopes	4,230	0.3
91B	Williams-Noonan loams, 3 to 6 percent slopes	1,735	0.1
91C	Williams-Noonan loams, 6 to 9 percent slopes	710	0.1
93C	Williams-Zahl loams, 6 to 9 percent slopes	4,750	0.4
93D	Zahl-Williams loams, 9 to 15 percent slopes	8,765	0.7
93E	Zahl-Williams loams, 15 to 25 percent slopes	10,130	0.8
94B	Moreau Variant clay loam, 1 to 6 percent slopes	1,375	0.1
94E	Wayden silty clay, 9 to 25 percent slopes	7,020	0.5
101B	Amor loam, 3 to 6 percent slopes	18,205	1.4
101C	Amor loam, 6 to 9 percent slopes	13,955	1.0
102	Shambo loam, 1 to 3 percent slopes	4,945	0.4
102B	Shambo loam, 3 to 6 percent slopes	4,660	0.3
105	Harriet silt loam	16,700	1.3
106B	Daglum silt loam, 1 to 6 percent slopes	13,680	1.0
107	Aquents, ponded	1,470	0.1
109B	Ekalaka fine sandy loam, 1 to 6 percent slopes	885	0.1
207F	Arikara loam, 9 to 75 percent slopes	3,880	0.3
209E	Cherry-Cabba complex, 9 to 25 percent slopes	25,910	1.9
211F	Badland-Cabba-Arikara complex, 25 to 120 percent slopes	130,900	9.8
	Water	56,830	4.3
	Total	1,331,840	100.0

* Less than 0.1 percent.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE

[Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil]

Soil name and map symbol	Spring wheat	Barley	Oats	Corn silage	Grass-legume hay
	Bu	Bu	Bu	Ton	Ton
3------------------------- Straw	---	---	---	---	---
4------------------------- Arnegard	31	53	62	5.5	2.2
4B------------------------ Arnegard	28	47	56	5.0	2.0
5------------------------- Tonka*	23	39	46	4.1	1.6
7------------------------- Straw-Rhoades	23	39	46	4.1	1.6
8C------------------------ Cabba-Chama	12	20	24	2.2	0.9
9D------------------------ Amor-Cabba	11	19	22	1.9	0.8
9E, 10D------------------- Cabba	---	---	---	---	---
11F----------------------- Cabba-Badland	---	---	---	---	---
12------------------------ Banks	---	---	---	---	---
13D----------------------- Wabek	---	---	---	---	---
15------------------------ Belfield-Farland	23	39	46	4.1	1.6
16B----------------------- Belfield-Savage	22	37	44	3.8	1.5
18------------------------ Belfield-Grail	24	41	48	4.4	1.8
19B----------------------- Belfield-Morton	22	37	44	3.8	1.5
21B----------------------- Cherry	21	36	42	3.7	1.5
21C----------------------- Cherry	18	30	36	3.0	1.2
22------------------------ Colvin	15	30	30	2.7	1.1
24------------------------ Dimmick	---	---	---	---	---
25F----------------------- Baahish-Rock outcrop	---	---	---	---	---
27------------------------ Farland	27	46	54	4.7	1.9
27B----------------------- Farland	24	41	48	4.4	1.8

See footnotes at the end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Spring wheat	Barley	Oats	Corn silage	Grass-legume hay
	Bu	Bu	Bu	Ton	Ton
29B------------------------ Farland-Rhoades	20	34	40	3.6	1.4
30E------------------------ Cohagen-Vebar	---	---	---	---	---
31F------------------------ Cohagen-Vebar-Rock outcrop	---	---	---	---	---
32B------------------------ Flaxton-Williams	21	36	42	3.7	1.5
32C------------------------ Flaxton-Williams	16	28	33	2.8	1.1
33------------------------- Grail	31	53	62	5.5	2.2
33B------------------------ Grail	28	47	56	5.0	2.0
35------------------------- Lawther	28	47	56	5.0	2.0
35B------------------------ Lawther	24	41	48	4.4	1.8
37------------------------- Trembles Variant	---	---	---	---	---
39------------------------- Havrelon	27	46	54	4.7	1.9
40------------------------- Havrelon	---	---	---	---	---
41------------------------- Heil	---	---	---	---	---
42B------------------------ Lefor	19	31	37	3.2	1.3
42C------------------------ Lefor	15	26	30	2.7	1.1
43B------------------------ Havrelon	24	42	49	4.2	1.7
44B------------------------ Lihen	13	21	25	2.2	1.0
44D------------------------ Lihen	---	---	---	---	---
45B------------------------ Ruso	13	22	26	2.5	1.0
45C------------------------ Ruso	10	17	20	1.7	0.8
46------------------------- Bowdle	21	36	42	3.7	1.4
46B------------------------ Bowdle	19	31	37	3.2	1.2
47------------------------- Moreau	20	34	40	3.6	1.4

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Spring wheat	Barley	Oats	Corn silage	Grass-legume hay
	Bu	Bu	Bu	Ton	Ton
47B----------------------- Moreau	18	30	36	3.0	1.2
47C----------------------- Moreau	13	22	26	2.5	1.0
48B----------------------- Temvik	24	41	48	4.4	1.8
49----------------------- Morton	27	46	54	4.7	1.9
49B----------------------- Morton	24	41	48	4.4	1.8
49C----------------------- Morton	19	32	38	3.3	1.3
51C----------------------- Amor	---	---	---	---	---
52B----------------------- Morton-Rhoades	20	34	40	3.6	1.4
52C----------------------- Morton-Rhoades	15	26	30	2.7	1.1
53B----------------------- Watrous	18	30	36	3.0	1.2
54B----------------------- Parshall	21	36	42	3.6	1.4
55**----------------------- Pits	---	---	---	---	---
58----------------------- Regent	27	46	54	4.7	1.9
58B----------------------- Regent	24	40	47	4.2	1.7
58C----------------------- Regent	20	34	40	3.6	1.4
61B----------------------- Regent-Rhoades	20	34	40	3.6	1.4
61C----------------------- Regent-Rhoades	15	26	30	2.7	1.1
62B----------------------- Rhoades	---	---	---	---	---
62D----------------------- Rhoades-Cabba	---	---	---	---	---
64**----------------------- Badland	---	---	---	---	---
67----------------------- Savage	27	46	54	4.7	1.9
67B----------------------- Savage	24	40	47	4.3	1.7
68----------------------- Vanda	---	---	---	---	---

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Spring wheat	Barley	Oats	Corn silage	Grass-legume hay
	Bu	Bu	Bu	Ton	Ton
69B------------------------ Savage-Rhoades	21	36	42	3.7	1.4
70C------------------------ Searing	15	26	30	2.7	1.1
71B------------------------ Sen	24	41	48	4.4	1.8
71C------------------------ Sen	19	32	38	3.3	1.3
73C------------------------ Cherry-Vanda	---	---	---	---	---
75------------------------- Straw	31	53	62	5.5	2.2
79------------------------- Velva	22	37	44	3.8	1.5
81B------------------------ Vebar-Parshall	20	34	40	3.6	1.4
81C------------------------ Vebar-Parshall	18	30	36	3.0	1.2
81D, 82D------------------- Vebar	---	---	---	---	---
83E------------------------ Baahish	---	---	---	---	---
84------------------------- Hidatsa	20	34	40	3.6	1.4
84B------------------------ Hidatsa	18	30	36	3.0	1.2
86F------------------------ Brandenburg-Cabba	---	---	---	---	---
87F------------------------ Lakoa	---	---	---	---	---
88------------------------- Williams	27	46	54	4.7	1.9
88B------------------------ Williams	24	41	48	4.4	1.8
88C------------------------ Williams	19	32	38	3.3	1.3
90C------------------------ Williams	---	---	---	---	---
91B------------------------ Williams-Noonan	19	32	38	3.3	1.3
91C------------------------ Williams-Noonan	14	24	28	2.6	1.0
93C------------------------ Williams-Zahl	15	26	30	2.7	1.1
93D------------------------ Zahl-Williams	---	---	---	---	---

See footnotes at end of table.

TABLE 5.--YIELDS PER ACRE OF CROPS AND PASTURE--Continued

Soil name and map symbol	Spring wheat	Barley	Oats	Corn silage	Grass-legume hay
	Bu	Bu	Bu	Ton	Ton
93E: Zahl-Williams	---	---	---	---	---
94B: Moreau Variant	12	20	24	2.2	0.9
94E: Wayden	---	---	---	---	---
101B: Amor	23	39	46	4.1	1.6
101C: Amor	18	30	36	3.0	1.2
102: Shambo	27	46	54	4.7	1.9
102B: Shambo	24	41	48	4.4	1.8
105: Harriet	---	---	---	---	---
106B: Daglum	9	15	18	1.6	0.7
107**: Aquents	---	---	---	---	---
109B: Ekalaka	12	20	24	2.2	0.9
207F: Arikara	---	---	---	---	---
209E: Cherry-Cabba	---	---	---	---	---
211F: Badland-Cabba-Arikara	---	---	---	---	---

* For drained areas.
** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES

[Only the soils that support rangeland vegetation suitable for grazing are listed]

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
3 Straw	Overflow	Favorable	3,400	Big bluestem	20
		Normal	2,900	Western wheatgrass	20
		Unfavorable	2,400	Green needlegrass	15
				Needleandthread	5
4 Arnegard	Overflow	Favorable	3,400	Big bluestem	20
		Normal	2,900	Western wheatgrass	20
		Unfavorable	2,400	Green needlegrass	15
				Needleandthread	5
4B Arnegard	Silty	Favorable	2,300	Western wheatgrass	25
		Normal	2,000	Needleandthread	15
		Unfavorable	1,700	Blue grama	15
				Green needlegrass	10
5 Tonka	Wet Meadow	Favorable	4,500	Prairie cordgrass	25
		Normal	4,000	Slim sedge	15
		Unfavorable	3,500	Wooly sedge	15
				Northern reedgrass	10
7*:					
Straw	Overflow	Favorable	3,400	Big bluestem	20
		Normal	2,900	Western wheatgrass	20
		Unfavorable	2,400	Green needlegrass	15
				Needleandthread	5
Rhoades	Thin Claypan	Favorable	900	Western wheatgrass	30
		Normal	700	Blue grama	30
		Unfavorable	500	Sandberg bluegrass	5
8C*:					
Cabba	Shallow	Favorable	1,700	Little bluestem	35
		Normal	1,500	Needleandthread	10
		Unfavorable	1,200	Western wheatgrass	10
				Prairie sandreed	5
				Plains muhly	5
				Blue grama	5
				Sideoats grama	5
Chama	Silty	Favorable	2,300	Western wheatgrass	25
		Normal	2,000	Needleandthread	15
		Unfavorable	1,700	Blue grama	15
				Green needlegrass	10
9D*:					
Amor	Silty	Favorable	2,300	Western wheatgrass	25
		Normal	2,000	Needleandthread	15
		Unfavorable	1,700	Blue grama	15
				Green needlegrass	7
Cabba	Shallow	Favorable	1,700	Little bluestem	35
		Normal	1,500	Needleandthread	10
		Unfavorable	1,200	Western wheatgrass	10
				Prairie sandreed	5
				Plains muhly	5
				Blue grama	5
				Sideoats grama	5
9E Cabba	Shallow	Favorable	1,700	Little bluestem	35
		Normal	1,500	Needleandthread	10
		Unfavorable	1,200	Western wheatgrass	10
				Prairie sandreed	5
				Plains muhly	5
				Blue grama	5
				Sideoats grama	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
10D----------------- Cabba	Shallow------------------------	Favorable Normal Unfavorable	1,700 1,500 1,200	Little bluestem--------------- Western wheatgrass------------ Needleandthread--------------- Prairie sandreed-------------- Blue grama-------------------- Sideoats grama---------------- Plains muhly------------------	35 10 10 5 5 5 5
11F*: Cabba--------------	Shallow------------------------	Favorable Normal Unfavorable	1,700 1,500 1,200	Little bluestem--------------- Needleandthread--------------- Western wheatgrass------------ Prairie sandreed-------------- Plains muhly------------------ Blue grama-------------------- Sideoats grama----------------	35 10 10 5 5 5 5
Badland.					
12----------------- Banks	Sands--------------------------	Favorable Normal Unfavorable	2,500 2,300 2,000	Prairie sandreed-------------- Needleandthread--------------- Blue grama-------------------- Sand bluestem----------------- Little bluestem---------------	20 20 10 5 5
13D----------------- Wabek	Very Shallow-------------------	Favorable Normal Unfavorable	900 700 500	Needleandthread--------------- Blue grama-------------------- Little bluestem--------------- Western wheatgrass------------	20 15 15 10
15*: Belfield----------	Clayey-------------------------	Favorable Normal Unfavorable	2,300 2,000 1,700	Western wheatgrass------------ Green needlegrass------------- Blue grama--------------------	40 10 10
Farland-----------	Silty--------------------------	Favorable Normal Unfavorable	2,300 2,000 1,700	Western wheatgrass------------ Needleandthread--------------- Blue grama-------------------- Green needlegrass-------------	25 15 15 10
16B*: Belfield----------	Clayey-------------------------	Favorable Normal Unfavorable	2,300 2,000 1,700	Western wheatgrass------------ Green needlegrass------------- Blue grama--------------------	40 10 10
Savage------------	Clayey-------------------------	Favorable Normal Unfavorable	2,300 2,000 1,700	Western wheatgrass------------ Green needlegrass------------- Blue grama--------------------	40 10 10
18*: Belfield----------	Clayey-------------------------	Favorable Normal Unfavorable	2,300 2,000 1,700	Western wheatgrass------------ Green needlegrass------------- Blue grama--------------------	40 10 10
Grail-------------	Overflow-----------------------	Favorable Normal Unfavorable	3,400 2,900 2,400	Big bluestem------------------ Western wheatgrass------------ Green needlegrass------------- Needleandthread---------------	20 20 15 5
19B*: Belfield----------	Clayey-------------------------	Favorable Normal Unfavorable	2,300 2,000 1,700	Western wheatgrass------------ Green needlegrass------------- Blue grama--------------------	40 10 10
Morton------------	Silty--------------------------	Favorable Normal Unfavorable	2,300 2,000 1,700	Western wheatgrass------------ Needleandthread--------------- Blue grama-------------------- Green needlegrass-------------	25 15 15 10

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
21B, 21C: Cherry	Silty	Favorable	2,300	Western wheatgrass	25
		Normal	2,000	Needleandthread	15
		Unfavorable	1,700	Blue grama	15
				Green needlegrass	10
22: Colvin	Saline Lowland	Favorable	3,200	Western wheatgrass	40
		Normal	2,800	Slender wheatgrass	15
		Unfavorable	2,400	Inland saltgrass	10
				Nuttall alkaligrass	10
				Foxtail barley	5
24: Dimmick	Wetland	Favorable	5,700	Rivergrass	20
		Normal	5,200	Prairie cordgrass	20
		Unfavorable	4,700	Slough sedge	15
25F*:					
Baahish	Very Shallow	Favorable	900	Needleandthread	20
		Normal	700	Blue grama	15
		Unfavorable	500	Little bluestem	15
				Western wheatgrass	10
				Sedge	10
Rock outcrop.					
27, 27B: Farland	Silty	Favorable	2,300	Western wheatgrass	25
		Normal	2,000	Needleandthread	15
		Unfavorable	1,700	Blue grama	15
				Green needlegrass	10
29B*:					
Farland	Silty	Favorable	2,300	Western wheatgrass	25
		Normal	2,000	Needleandthread	15
		Unfavorable	1,700	Blue grama	15
				Green needlegrass	10
Rhoades	Thin Claypan	Favorable	900	Western wheatgrass	30
		Normal	700	Blue grama	30
		Unfavorable	500	Sandberg bluegrass	5
30E*:					
Cohagen	Shallow	Favorable	1,700	Little bluestem	35
		Normal	1,500	Needleandthread	10
		Unfavorable	1,200	Western wheatgrass	10
				Threadleaf sedge	10
				Prairie sandreed	5
				Plains muhly	5
				Blue grama	5
				Sideoats grama	5
Vebar	Sandy	Favorable	2,400	Needleandthread	20
		Normal	2,100	Prairie sandreed	20
		Unfavorable	1,800	Western wheatgrass	10
				Blue grama	10
31F*:					
Cohagen	Shallow	Favorable	1,700	Little bluestem	35
		Normal	1,500	Needleandthread	10
		Unfavorable	1,200	Western wheatgrass	10
				Threadleaf sedge	10
				Prairie sandreed	5
				Plains muhly	5
				Blue grama	5
				Sideoats grama	5
Vebar	Sandy	Favorable	2,400	Needleandthread	20
		Normal	2,100	Prairie sandreed	20
		Unfavorable	1,800	Western wheatgrass	10
				Blue grama	10

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
31F*:					
Rock outcrop.					
32B*, 32C*:					
Flaxton	Sandy	Favorable	2,400	Needleandthread	20
		Normal	2,100	Prairie sandreed	20
		Unfavorable	1,800	Western wheatgrass	10
				Blue grama	10
Williams	Silty	Favorable	2,300	Western wheatgrass	25
		Normal	2,000	Needleandthread	15
		Unfavorable	1,700	Blue grama	15
				Green needlegrass	10
33 Grail	Overflow	Favorable	3,400	Big bluestem	20
		Normal	2,900	Western wheatgrass	20
		Unfavorable	2,400	Green needlegrass	15
				Needleandthread	5
33B Grail	Silty	Favorable	2,300	Western wheatgrass	25
		Normal	2,000	Needleandthread	15
		Unfavorable	1,700	Blue grama	15
				Green needlegrass	10
35, 35B Lawther	Clayey	Favorable	2,300	Western wheatgrass	40
		Normal	2,000	Green needlegrass	10
		Unfavorable	1,700	Blue grama	10
37 Trembles Variant	Overflow	Favorable	3,400	Big bluestem	20
		Normal	2,900	Western wheatgrass	20
		Unfavorable	2,400	Green needlegrass	15
				Needleandthread	5
39, 40 Havrelon	Overflow	Favorable	3,400	Big bluestem	20
		Normal	2,900	Western wheatgrass	20
		Unfavorable	2,400	Green needlegrass	15
				Needleandthread	5
41 Heil	Closed Depression	Favorable	3,000	Western wheatgrass	55
		Normal	2,600	Prairie cordgrass	10
		Unfavorable	2,200		
42B, 42C Lefor	Sandy	Favorable	2,400	Prairie sandreed	20
		Normal	2,100	Needleandthread	20
		Unfavorable	1,800	Western wheatgrass	10
				Blue grama	10
43B Havrelon	Overflow	Favorable	3,400	Big bluestem	20
		Normal	2,900	Western wheatgrass	20
		Unfavorable	2,400	Green needlegrass	15
				Needleandthread	5
44B, 44D Lihen	Sands	Favorable	2,500	Prairie sandreed	20
		Normal	2,300	Needleandthread	20
		Unfavorable	2,000	Blue grama	10
				Little bluestem	5
				Sand bluestem	5
45B, 45C Ruso	Sandy	Favorable	2,400	Needleandthread	20
		Normal	2,100	Prairie sandreed	20
		Unfavorable	1,800	Blue grama	10
				Western wheatgrass	10
46, 46B Bowdle	Silty	Favorable	2,300	Western wheatgrass	25
		Normal	2,000	Needleandthread	15
		Unfavorable	1,700	Blue grama	15
				Green needlegrass	10

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Compo-sition
			Lb/acre		Pct
47, 47B, 47C: Moreau	Clayey	Favorable	2,300	Western wheatgrass	40
		Normal	2,000	Green needlegrass	10
		Unfavorable	1,700	Blue grama	10
48B: Temvik	Silty	Favorable	2,300	Western wheatgrass	25
		Normal	2,000	Needleandthread	15
		Unfavorable	1,700	Blue grama	15
				Green needlegrass	10
49, 49B, 49C: Morton	Silty	Favorable	2,300	Western wheatgrass	25
		Normal	2,000	Needleandthread	15
		Unfavorable	1,700	Blue grama	15
				Green needlegrass	10
51C: Amor	Silty	Favorable	2,300	Western wheatgrass	25
		Normal	2,000	Needleandthread	15
		Unfavorable	1,700	Blue grama	15
				Green needlegrass	10
52B*, 52C*:					
Morton	Silty	Favorable	2,300	Western wheatgrass	25
		Normal	2,000	Needleandthread	15
		Unfavorable	1,700	Blue grama	15
				Green needlegrass	10
Rhoades	Thin Claypan	Favorable	900	Western wheatgrass	30
		Normal	700	Blue grama	30
		Unfavorable	500	Sandberg bluegrass	5
53B: Watrous	Silty	Favorable	2,300	Western wheatgrass	25
		Normal	2,000	Needleandthread	15
		Unfavorable	1,700	Blue grama	15
				Green needlegrass	10
54B: Parshall	Sandy	Favorable	2,400	Prairie sandreed	20
		Normal	2,100	Needleandthread	20
		Unfavorable	1,800	Western wheatgrass	10
				Blue grama	10
58, 58B, 58C: Regent	Clayey	Favorable	2,300	Western wheatgrass	40
		Normal	2,000	Green needlegrass	10
		Unfavorable	1,700	Blue grama	10
61B*, 61C*:					
Regent	Clayey	Favorable	2,300	Western wheatgrass	40
		Normal	2,000	Green needlegrass	10
		Unfavorable	1,700	Blue grama	10
Rhoades	Thin Claypan	Favorable	900	Western wheatgrass	30
		Normal	700	Blue grama	30
		Unfavorable	500	Sandberg bluegrass	5
62B: Rhoades	Thin Claypan	Favorable	900	Western wheatgrass	30
		Normal	700	Blue grama	30
		Unfavorable	500	Sandberg bluegrass	5
62D*:					
Rhoades	Thin Claypan	Favorable	900	Western wheatgrass	30
		Normal	700	Blue grama	30
		Unfavorable	500	Sandberg bluegrass	5
Cabba	Shallow	Favorable	1,700	Little bluestem	35
		Normal	1,500	Needleandthread	10
		Unfavorable	1,200	Western wheatgrass	10
				Prairie sandreed	5
				Plains muhly	5
				Blue grama	5
				Sideoats grama	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production		Characteristic vegetation	Composition
		Kind of year	Dry weight		
			Lb/acre		Pct
67, 67B Savage	Clayey	Favorable	2,300	Western wheatgrass	40
		Normal	2,000	Green needlegrass	10
		Unfavorable	1,700	Blue grama	10
68 Vanda	Thin Claypan	Favorable	900	Western wheatgrass	30
		Normal	700	Blue grama	30
		Unfavorable	500	Sandberg bluegrass	5
69B*: Savage	Clayey	Favorable	2,300	Western wheatgrass	40
		Normal	2,000	Green needlegrass	10
		Unfavorable	1,700	Blue grama	10
Rhoades	Thin Claypan	Favorable	900	Western wheatgrass	30
		Normal	700	Blue grama	30
		Unfavorable	500	Sandberg bluegrass	5
70C Searing	Silty	Favorable	2,300	Western wheatgrass	25
		Normal	2,000	Needleandthread	15
		Unfavorable	1,700	Blue grama	15
				Green needlegrass	10
71B, 71C Sen	Silty	Favorable	2,300	Western wheatgrass	25
		Normal	2,000	Needleandthread	15
		Unfavorable	1,700	Blue grama	15
				Green needlegrass	10
73C*: Cherry	Silty	Favorable	2,300	Western wheatgrass	25
		Normal	2,000	Needleandthread	15
		Unfavorable	1,700	Blue grama	15
				Green needlegrass	10
Vanda	Thin Claypan	Favorable	900	Western wheatgrass	30
		Normal	700	Blue grama	30
		Unfavorable	500	Sandberg bluegrass	5
75 Straw	Overflow	Favorable	3,400	Big bluestem	20
		Normal	2,900	Western wheatgrass	20
		Unfavorable	2,400	Green needlegrass	15
				Needleandthread	5
79 Velva	Overflow	Favorable	3,400	Big bluestem	30
		Normal	2,900	Western wheatgrass	25
		Unfavorable	2,400	Green needlegrass	20
81B*, 81C*: Vebar	Sandy	Favorable	2,400	Needleandthread	20
		Normal	2,100	Prairie sandreed	20
		Unfavorable	1,800	Western wheatgrass	10
				Blue grama	10
Parshall	Sandy	Favorable	2,400	Prairie sandreed	20
		Normal	2,100	Needleandthread	20
		Unfavorable	1,800	Western wheatgrass	10
				Blue grama	10
81D, 82D Vebar	Sandy	Favorable	2,400	Needleandthread	20
		Normal	2,100	Prairie sandreed	20
		Unfavorable	1,800	Western wheatgrass	10
				Blue grama	10
83E Baahish	Very Shallow	Favorable	900	Needleandthread	20
		Normal	700	Blue grama	15
		Unfavorable	500	Little bluestem	15
				Western wheatgrass	10
				Sedge	10

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
84, 84B: Hidatsa	Silty	Favorable	2,300	Western wheatgrass	25
		Normal	2,000	Needleandthread	15
		Unfavorable	1,700	Blue grama	15
				Green needlegrass	10
86F*:					
Brandenburg	Very Shallow	Favorable	900	Needleandthread	20
		Normal	700	Blue grama	15
		Unfavorable	500	Little bluestem	15
				Western wheatgrass	10
				Sedge	10
Cabba	Shallow	Favorable	1,700	Little bluestem	35
		Normal	1,500	Needleandthread	10
		Unfavorable	1,200	Western wheatgrass	10
				Prairie sandreed	5
				Plains muhly	5
				Blue grama	5
				Sideoats grama	5
88, 88B, 88C, 90C: Williams	Silty	Favorable	2,300	Western wheatgrass	25
		Normal	2,000	Needleandthread	15
		Unfavorable	1,700	Blue grama	15
				Green needlegrass	10
91B*, 91C*:					
Williams	Silty	Favorable	2,300	Western wheatgrass	25
		Normal	2,000	Needleandthread	15
		Unfavorable	1,700	Blue grama	15
				Green needlegrass	10
Noonan	Claypan	Favorable	1,600	Western wheatgrass	25
		Normal	1,400	Blue grama	20
		Unfavorable	1,200	Needleandthread	15
				Green needlegrass	5
				Sandberg bluegrass	5
93C*:					
Williams	Silty	Favorable	2,300	Western wheatgrass	25
		Normal	2,000	Needleandthread	15
		Unfavorable	1,700	Blue grama	15
				Green needlegrass	10
Zahl	Thin Upland	Favorable	1,800	Needleandthread	20
		Normal	1,600	Little bluestem	15
		Unfavorable	1,400	Western wheatgrass	15
				Green needlegrass	5
				Sideoats grama	5
93D*, 93E*:					
Zahl	Thin Upland	Favorable	1,800	Needleandthread	20
		Normal	1,600	Little bluestem	15
		Unfavorable	1,400	Western wheatgrass	15
				Green needlegrass	5
				Sideoats grama	5
Williams	Silty	Favorable	2,300	Western wheatgrass	25
		Normal	2,000	Needleandthread	15
		Unfavorable	1,700	Blue grama	15
				Green needlegrass	10
94B: Moreau Variant	Shallow	Favorable	1,700	Little bluestem	35
		Normal	1,500	Needleandthread	10
		Unfavorable	1,200	Western wheatgrass	10
				Blue grama	5
				Plains muhly	5

See footnote at end of table.

TABLE 6.--RANGELAND PRODUCTIVITY AND CHARACTERISTIC PLANT COMMUNITIES--Continued

Soil name and map symbol	Range site name	Total production: Kind of year	Total production: Dry weight	Characteristic vegetation	Composition
			Lb/acre		Pct
94E: Wayden	Shallow	Favorable	1,700	Little bluestem	35
		Normal	1,500	Needleandthread	10
		Unfavorable	1,200	Western wheatgrass	10
				Plains muhly	5
				Sideoats grama	5
				Blue grama	5
				Prairie sandreed	5
101B, 101C: Amor	Silty	Favorable	2,300	Western wheatgrass	25
		Normal	2,000	Needleandthread	15
		Unfavorable	1,700	Blue grama	15
				Green needlegrass	7
102, 102B: Shambo	Silty	Favorable	2,300	Western wheatgrass	25
		Normal	2,000	Needleandthread	15
		Unfavorable	1,700	Blue grama	15
				Green needlegrass	10
105: Harriet	Saline Lowland	Favorable	3,000	Western wheatgrass	35
		Normal	2,600	Inland saltgrass	20
		Unfavorable	2,200	Nuttall alkaligrass	15
				Slender wheatgrass	5
				Alkali cordgrass	5
106B: Daglum	Claypan	Favorable	1,600	Western wheatgrass	25
		Normal	1,400	Blue grama	20
		Unfavorable	1,200	Needleandthread	15
				Sandberg bluegrass	5
				Green needlegrass	5
109B: Ekalaka	Sandy	Favorable	2,400	Prairie sandreed	20
		Normal	2,100	Needleandthread	20
		Unfavorable	1,800	Western wheatgrass	10
				Blue grama	10
209E*:					
Cherry	Silty	Favorable	2,300	Western wheatgrass	25
		Normal	2,000	Needleandthread	15
		Unfavorable	1,700	Blue grama	15
				Green needlegrass	10
Cabba	Shallow	Favorable	1,700	Little bluestem	35
		Normal	1,500	Needleandthread	10
		Unfavorable	1,200	Western wheatgrass	10
				Prairie sandreed	5
				Plains muhly	5
				Blue grama	5
				Sideoats grama	5
211F*:					
Badland.					
Cabba	Shallow	Favorable	1,700	Little bluestem	35
		Normal	1,500	Needleandthread	10
		Unfavorable	1,200	Western wheatgrass	10
				Prairie sandreed	5
				Plains muhly	5
				Blue grama	5
				Sideoats grama	5
Arikara.					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

[The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil]

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
3. Straw	---	---	---	---	---
4, 4B. Arnegard	Peking cotoneaster, Tatarian honeysuckle, American plum.	Siberian crabapple, green ash, Black Hills spruce, common chokecherry, eastern redcedar, Siberian peashrub.	Golden willow, ponderosa pine.	Plains cottonwood	---
5. Tonka					
7*:					
Straw	---	Eastern redcedar, Rocky Mountain juniper, Siberian peashrub, Tatarian honeysuckle, American plum.	Green ash, ponderosa pine, Black Hills spruce, blue spruce.	Siberian elm	Eastern cottonwood.
Rhoades.					
8C*:					
Cabba.					
Chama	---	Black Hills spruce, eastern redcedar, Russian-olive, Tatarian honeysuckle, Siberian peashrub, American plum, common chokecherry, lilac.	Bur oak, green ash, Siberian crabapple, ponderosa pine.	---	---
9D*:					
Amor	---	Black Hills spruce, Russian-olive, Siberian peashrub, common chokecherry, eastern redcedar, Tatarian honeysuckle, American plum, lilac.	Bur oak, green ash, ponderosa pine, Siberian crabapple.	---	---
Cabba.					
9E, 10D. Cabba					
11F*:					
Cabba.					
Badland.					

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
12. Banks	---	Ponderosa pine, eastern redcedar, Rocky Mountain juniper.	---	---	---
13D. Wabek					
15*: Belfield	Siberian peashrub, golden currant, American plum, lilac.	Green ash, eastern redcedar, ponderosa pine, Rocky Mountain juniper, Russian-olive, common chokecherry.	Siberian elm	---	---
Farland	---	Black Hills spruce, Russian-olive, Siberian peashrub, common chokecherry, eastern redcedar, Tatarian honeysuckle, American plum, lilac.	Bur oak, green ash, Siberian crabapple, ponderosa pine.	---	---
16B*: Belfield	Siberian peashrub, golden currant, American plum, lilac.	Green ash, eastern redcedar, ponderosa pine, Rocky Mountain juniper, Russian-olive, common chokecherry.	Siberian elm	---	---
Savage	Lilac	Green ash, Siberian crabapple, Rocky Mountain juniper, common chokecherry, Siberian peashrub, American plum.	Siberian elm, ponderosa pine, blue spruce, Black Hills spruce, Russian-olive.	---	---
18*: Belfield	Siberian peashrub, golden currant, American plum, lilac.	Green ash, eastern redcedar, ponderosa pine, Rocky Mountain juniper, Russian-olive, common chokecherry.	Siberian elm	---	---
Grail	American plum, Tatarian honeysuckle, Peking cotoneaster.	Green ash, Black Hills spruce, Siberian crabapple, common chokecherry, eastern redcedar, Siberian peashrub.	Golden willow, ponderosa pine.	Plains cottonwood	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
19B*:					
Belfield	Siberian peashrub, golden currant, American plum, lilac.	Green ash, eastern redcedar, ponderosa pine, Rocky Mountain juniper, Russian-olive, common chokecherry.	Siberian elm	---	---
Morton	---	Black Hills spruce, Russian-olive, Siberian peashrub, common chokecherry, eastern redcedar, lilac, Tatarian honeysuckle, American plum.	Siberian crabapple, bur oak, green ash, ponderosa pine.	---	---
21B, 21C Cherry	---	Eastern redcedar, lilac, Russian-olive, Siberian peashrub, common chokecherry, Black Hills spruce, Tatarian honeysuckle, American plum.	Bur oak, Siberian crabapple, green ash, ponderosa pine.	---	---
22. Colvin					
24. Dimmick					
25F*: Baahish.					
Rock outcrop.					
27, 27B Farland	---	Black Hills spruce, Russian-olive, Siberian peashrub, common chokecherry, eastern redcedar, Tatarian honeysuckle, American plum, lilac.	Bur oak, green ash, Siberian crabapple, ponderosa pine.	---	---
29B*:					
Farland	---	Black Hills spruce, Russian-olive, Siberian peashrub, common chokecherry, eastern redcedar, Tatarian honeysuckle, American plum, lilac.	Bur oak, green ash, Siberian crabapple, ponderosa pine.	---	---
Rhoades.					
30E*: Cohagen.					
Vebar.					

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
31F*: Cohagen.					
Vebar.					
Rock outcrop.					
32B*, 32C*: Flaxton	Lilac, silver buffaloberry, Tatarian honeysuckle.	Siberian crabapple, Siberian peashrub, eastern redcedar, common chokecherry, American plum, bur oak.	Ponderosa pine, green ash, Russian-olive.	---	---
Williams	---	Russian-olive, eastern redcedar, lilac, Siberian peashrub, common chokecherry, Tatarian honeysuckle, American plum.	Siberian crabapple, green ash, ponderosa pine, bur oak, Black Hills spruce.	---	---
33, 33B Grail	American plum, Tatarian honeysuckle, Peking cotoneaster.	Green ash, Black Hills spruce, Siberian crabapple, common chokecherry, eastern redcedar, Siberian peashrub.	Golden willow, ponderosa pine.	Plains cottonwood	---
35, 35B Lawther	Golden currant, Siberian peashrub, lilac, American plum.	Green ash, ponderosa pine, Rocky Mountain juniper, Russian-olive, common chokecherry, eastern redcedar.	Siberian elm	---	---
37. Trembles Variant					
39, 40 Havrelon	Peking cotoneaster, Tatarian honeysuckle, American plum.	Siberian crabapple, green ash, Black Hills spruce, common chokecherry, eastern redcedar, Siberian peashrub.	Golden willow, ponderosa pine.	Plains cottonwood	---
41. Heil					
42B, 42C Lefor	Silver buffaloberry, American plum.	Siberian crabapple, lilac, Siberian peashrub, eastern redcedar, common chokecherry, Tatarian honeysuckle, bur oak.	Ponderosa pine, green ash, Russian-olive.	---	---

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of-- <8	8-15	16-25	26-35	>35
43B. Havrelon	Peking cotoneaster, Tatarian honeysuckle, American plum.	Siberian crabapple, green ash, Black Hills spruce, common chokecherry, eastern redcedar, Siberian peashrub.	Golden willow, ponderosa pine.	Plains cottonwood	---
44B, 44D. Lihen	Skunkbush sumac, western sandcherry.	Siberian peashrub, Rocky Mountain juniper, silver buffaloberry, green ash, blue spruce, lilac, common chokecherry, ponderosa pine.	Russian-olive, Siberian elm.	---	---
45B, 45C. Ruso	---	Green ash, ponderosa pine, Russian-olive, Siberian peashrub, eastern redcedar, Rocky Mountain juniper.	Siberian elm	---	---
46, 46B. Bowdle	---	Ponderosa pine, Russian-olive, eastern redcedar, Rocky Mountain juniper, Siberian peashrub.	Siberian elm, green ash.	---	---
47, 47B, 47C. Moreau	Golden currant, Siberian peashrub, lilac, American plum.	Green ash, ponderosa pine, eastern redcedar, Rocky Mountain juniper, Russian-olive, common chokecherry.	Siberian elm	---	---
48B. Temvik	---	Black Hills spruce, eastern redcedar, Russian-olive, Tatarian honeysuckle, Siberian peashrub, American plum, common chokecherry, lilac.	Bur oak, green ash, Siberian crabapple, ponderosa pine.	---	---
49, 49B, 49C. Morton	---	Black Hills spruce, Russian-olive, Siberian peashrub, common chokecherry, eastern redcedar, lilac, Tatarian honeysuckle, American plum.	Siberian crabapple, bur oak, green ash, ponderosa pine.	---	---
51C. Amor					

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
52B*, 52C*:					
Morton	---	Black Hills spruce, Russian-olive, Siberian peashrub, common chokecherry, eastern redcedar, lilac, Tatarian honeysuckle, American plum.	Siberian crabapple, bur oak, green ash, ponderosa pine.	---	---
Rhoades.					
53B Watrous	---	American plum, Black Hills spruce, Russian-olive, Siberian peashrub, common chokecherry, eastern redcedar, lilac, Tatarian honeysuckle.	Bur oak, green ash, ponderosa pine, Siberian crabapple.	---	---
54B Parshall	Peking cotoneaster, Tatarian honeysuckle, American plum.	Black Hills spruce, Siberian crabapple, green ash, common chokecherry, eastern redcedar, Siberian peashrub.	Golden willow, ponderosa pine.	Plains cottonwood	---
55*. Pits					
58, 58B, 58C Regent	Siberian peashrub, lilac, American plum, golden currant.	Ponderosa pine, green ash, Russian-olive, common chokecherry, Rocky Mountain juniper, eastern redcedar.	Siberian elm	---	---
61B*, 61C*:					
Regent	Siberian peashrub, lilac, American plum, golden currant.	Ponderosa pine, green ash, Russian-olive, common chokecherry, Rocky Mountain juniper, eastern redcedar.	Siberian elm	---	---
Rhoades.					
62B. Rhoades					
62D*:					
Rhoades.					
Cabba.					
64*. Badland					

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of-- <8	8-15	16-25	26-35	>35
67, 67B: Savage	Lilac	Green ash, Siberian crabapple, Rocky Mountain juniper, common chokecherry, Siberian peashrub, American plum.	Siberian elm, ponderosa pine, blue spruce, Black Hills spruce, Russian-olive.	---	---
68. Vanda					
69B*: Savage	Lilac	Green ash, Siberian crabapple, Rocky Mountain juniper, common chokecherry, Siberian peashrub, American plum.	Siberian elm, ponderosa pine, blue spruce, Black Hills spruce, Russian-olive.	---	---
Rhoades.					
70C: Searing	---	Ponderosa pine, eastern redcedar, Russian-olive, Siberian peashrub, Rocky Mountain juniper.	Siberian elm, green ash.	---	---
71B, 71C: Sen	---	Black Hills spruce, Russian-olive, Siberian peashrub, common chokecherry, eastern redcedar, Tatarian honeysuckle, American plum, lilac.	Siberian crabapple, bur oak, green ash, ponderosa pine.	---	---
73C*: Cherry	---	Eastern redcedar, lilac, Russian-olive, Siberian peashrub, common chokecherry, Black Hills spruce, Tatarian honeysuckle, American plum.	Bur oak, Siberian crabapple, green ash, ponderosa pine.	---	---
Vanda.					
75: Straw	---	Eastern redcedar, Rocky Mountain juniper, Siberian peashrub, Tatarian honeysuckle, American plum.	Green ash, ponderosa pine, Black Hills spruce, blue spruce.	Siberian elm	Eastern cottonwood.

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
79: Velva	Tatarian honeysuckle, American plum, Peking cotoneaster.	Green ash, Black Hills spruce, Siberian crabapple, Siberian peashrub, common chokecherry, eastern redcedar.	Golden willow, ponderosa pine.	Plains cottonwood	---
81B*:					
Vebar	Tatarian honeysuckle, lilac, silver buffaloberry.	Bur oak, Siberian peashrub, eastern redcedar, common chokecherry, American plum, Siberian crabapple.	Russian-olive, green ash, ponderosa pine.	---	---
Parshall	Peking cotoneaster, Tatarian honeysuckle, American plum.	Black Hills spruce, Siberian crabapple, green ash, common chokecherry, eastern redcedar, Siberian peashrub.	Golden willow, ponderosa pine.	Plains cottonwood	---
81C*:					
Vebar	Tatarian honeysuckle, lilac, silver buffaloberry.	Bur oak, Siberian peashrub, eastern redcedar, common chokecherry, American plum, Siberian crabapple.	Russian-olive, green ash, ponderosa pine.	---	---
Parshall	Silver buffaloberry, American plum.	Bur oak, eastern redcedar, Tatarian honeysuckle, Siberian crabapple, common chokecherry, Siberian peashrub, lilac.	Ponderosa pine, Russian-olive, green ash.	---	---
81D: Vebar	---	Ponderosa pine, eastern redcedar, Rocky Mountain juniper.	---	---	---
82D. Vebar					
83E. Baahish					
84, 84B: Hidatsa	---	Ponderosa pine, Siberian peashrub, Rocky Mountain juniper, Russian-olive, eastern redcedar.	Siberian elm, green ash.	---	---
86F*:					
Brandenburg.					
Cabba.					

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of-- <8	8-15	16-25	26-35	>35
87F. Lakoa					
88, 88B, 88C------ Williams	---	Russian-olive, eastern redcedar, lilac, Siberian peashrub, common chokecherry, Tatarian honeysuckle, American plum.	Siberian crabapple, green ash, ponderosa pine, bur oak, Black Hills spruce.	---	---
90C. Williams					
91B*, 91C*: Williams---------	---	Russian-olive, eastern redcedar, lilac, Siberian peashrub, common chokecherry, Tatarian honeysuckle, American plum.	Siberian crabapple, green ash, ponderosa pine, bur oak, Black Hills spruce.	---	---
Noonan-----------	Green ash, Russian-olive, eastern redcedar, Rocky Mountain juniper, Siberian peashrub, silver buffaloberry.	Siberian elm, ponderosa pine.	---	---	---
93C*: Williams---------	---	Russian-olive, eastern redcedar, lilac, Siberian peashrub, common chokecherry, Tatarian honeysuckle, American plum.	Siberian crabapple, green ash, ponderosa pine, bur oak, Black Hills spruce.	---	---
Zahl-------------	Eastern redcedar, Siberian peashrub, Tatarian honeysuckle.	Ponderosa pine, green ash, Russian-olive, Rocky Mountain juniper.	Siberian elm------	---	---
93D*: Zahl.					
Williams---------	---	Russian-olive, eastern redcedar, lilac, Siberian peashrub, common chokecherry, Tatarian honeysuckle, American plum.	Siberian crabapple, green ash, ponderosa pine, bur oak, Black Hills spruce.	---	---
93E*: Zahl.					
Williams.					

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
94B. Moreau Variant					
94E. Wayden					
101B, 101C: Amor	---	Black Hills spruce, Russian-olive, Siberian peashrub, common chokecherry, eastern redcedar, Tatarian honeysuckle, American plum, lilac.	Bur oak, green ash, ponderosa pine, Siberian crabapple.	---	---
102, 102B: Shambo	---	Black Hills spruce, eastern redcedar, Russian-olive, Siberian peashrub, common chokecherry, lilac, Tatarian honeysuckle, American plum.	Bur oak, Siberian crabapple, green ash, ponderosa pine.	---	---
105. Harriet					
106B: Daglum	Green ash, Russian-olive, eastern redcedar, Rocky Mountain juniper, Siberian peashrub, silver buffaloberry.	Siberian elm, ponderosa pine.	---	---	---
107*. Aquents					
109B: Ekalaka	Green ash, Russian-olive, eastern redcedar, Rocky Mountain juniper, Siberian peashrub, silver buffaloberry.	Siberian elm, ponderosa pine.	---	---	---
207F. Arikara					
209E*: Cherry	---	Eastern redcedar, lilac, Russian-olive, Siberian peashrub, common chokecherry, Black Hills spruce, Tatarian honeysuckle, American plum.	Bur oak, Siberian crabapple, green ash, ponderosa pine.	---	---
Cabba.					
211F*: Badland.					
Cabba.					

See footnote at end of table.

TABLE 7.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average heights, in feet, of--				
	<8	8-15	16-25	26-35	>35
211F*: Arikara.					

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
3 Straw	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.
4, 4B Arnegard	Slight	Slight	Moderate: slope.	Slight.
5 Tonka	Severe: ponding.	Severe: ponding.	Severe: ponding.	Severe: ponding.
7*:				
Straw	Severe: flooding.	Slight	Moderate: flooding.	Slight.
Rhoades	Severe: flooding, excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
8C*:				
Cabba	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: erodes easily.
Chama	Slight	Slight	Severe: slope.	Slight.
9D*:				
Amor	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Cabba	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: erodes easily.
9E Cabba	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, erodes easily.
10D Cabba	Severe: large stones, depth to rock.	Severe: large stones, depth to rock.	Severe: large stones, slope, depth to rock.	Moderate: large stones.
11F*:				
Cabba	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, erodes easily.
Badland.				
12 Banks	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.
13D Wabek	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
15*:				
Belfield	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
Farland	Slight	Slight	Moderate: slope.	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
16B*:				
Belfield	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
Savage	Slight	Slight	Moderate: slope.	Severe: erodes easily.
18*:				
Belfield	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
Grail	Slight	Slight	Moderate: slope.	Slight.
19B*:				
Belfield	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
Morton	Slight	Slight	Moderate: slope, depth to rock.	Slight.
21B Cherry	Slight	Slight	Moderate: slope.	Severe: erodes easily.
21C Cherry	Slight	Slight	Severe: slope.	Severe: erodes easily.
22 Colvin	Severe: flooding, wetness, excess salt.	Severe: wetness, excess salt.	Severe: wetness, flooding, excess salt.	Severe: wetness.
24 Dimmick	Severe: ponding, percs slowly, too clayey.	Severe: ponding, too clayey, percs slowly.	Severe: too clayey, ponding, percs slowly.	Severe: ponding, too clayey.
25F*:				
Baahish	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Rock outcrop.				
27, 27B Farland	Slight	Slight	Moderate: slope.	Slight.
29B*:				
Farland	Slight	Slight	Moderate: slope.	Slight.
Rhoades	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
30E*:				
Cohagen	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Moderate: slope.
Vebar	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
31F*:				
Cohagen	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
31F*:				
Vebar	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Rock outcrop.				
32B*:				
Flaxton	Slight	Slight	Moderate: slope.	Slight.
Williams	Slight	Slight	Moderate: slope.	Slight.
32C*:				
Flaxton	Slight	Slight	Severe: slope.	Slight.
Williams	Slight	Slight	Severe: slope.	Slight.
33, 33B Grail	Slight	Slight	Moderate: slope.	Slight.
35, 35B Lawther	Moderate: too clayey.	Moderate: too clayey.	Moderate: slope, too clayey.	Moderate: too clayey.
37 Trembles Variant	Severe: flooding, ponding.	Severe: ponding.	Severe: ponding, flooding.	Severe: ponding.
39 Havrelon	Severe: flooding.	Slight	Moderate: flooding.	Slight.
40 Havrelon	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.
41 Heil	Severe: ponding, percs slowly.	Severe: ponding, excess sodium.	Severe: ponding, percs slowly.	Severe: ponding.
42B Lefor	Slight	Slight	Moderate: slope, depth to rock.	Slight.
42C Lefor	Slight	Slight	Severe: slope.	Slight.
43B Havrelon	Severe: flooding.	Slight	Moderate: flooding.	Slight.
44B Lihen	Slight	Slight	Moderate: slope, small stones.	Slight.
44D Lihen	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
45B Ruso	Slight	Slight	Moderate: slope.	Slight.
45C Ruso	Slight	Slight	Severe: slope.	Slight.
46 Bowdle	Slight	Slight	Slight	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
46B Bowdle	Slight	Slight	Moderate: slope.	Slight.
47, 47B Moreau	Moderate: too clayey.	Moderate: too clayey.	Moderate: slope, too clayey.	Moderate: too clayey.
47C Moreau	Moderate: too clayey.	Moderate: too clayey.	Severe: slope.	Moderate: too clayey.
48B Temvik	Slight	Slight	Moderate: slope.	Slight.
49, 49B Morton	Slight	Slight	Moderate: slope, depth to rock.	Slight.
49C Morton	Slight	Slight	Severe: slope.	Slight.
51C Amor	Severe: large stones.	Severe: large stones.	Severe: large stones.	Slight.
52B*: Morton	Slight	Slight	Moderate: slope, depth to rock.	Slight.
Rhoades	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
52C*: Morton	Slight	Slight	Severe: slope.	Slight.
Rhoades	Severe: excess sodium.	Severe: excess sodium.	Severe: slope, excess sodium.	Slight.
53B Watrous	Slight	Slight	Moderate: slope, depth to rock.	Slight.
54B Parshall	Slight	Slight	Moderate: slope.	Slight.
55*. Pits				
58, 58B Regent	Slight	Slight	Moderate: slope.	Slight.
58C Regent	Slight	Slight	Severe: slope.	Slight.
61B*: Regent	Slight	Slight	Moderate: slope.	Slight.
Rhoades	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
61C*: Regent	Slight	Slight	Severe: slope.	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
61C*:				
Rhoades	Severe: excess sodium.	Severe: excess sodium.	Severe: slope, excess sodium.	Slight.
62B Rhoades	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
62D*:				
Rhoades	Severe: excess sodium.	Severe: excess sodium.	Severe: slope, excess sodium.	Slight.
Cabba	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: erodes easily.
64*. Badland				
67, 67B Savage	Slight	Slight	Moderate: slope.	Severe: erodes easily.
68 Vanda	Severe: excess salt.	Severe: excess salt.	Severe: excess salt.	Severe: erodes easily.
69B*:				
Savage	Slight	Slight	Moderate: slope.	Severe: erodes easily.
Rhoades	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
70C Searing	Slight	Slight	Severe: slope.	Slight.
71B Sen	Slight	Slight	Moderate: slope, depth to rock.	Slight.
71C Sen	Slight	Slight	Severe: slope.	Slight.
73C*:				
Cherry	Slight	Slight	Severe: slope.	Severe: erodes easily.
Vanda	Severe: excess salt.	Severe: excess salt.	Severe: slope, excess salt.	Severe: erodes easily.
75 Straw	Severe: flooding.	Slight	Moderate: flooding.	Slight.
79 Velva	Severe: flooding.	Slight	Moderate: flooding.	Slight.
81B*:				
Vebar	Slight	Slight	Moderate: slope, depth to rock.	Slight.
Parshall	Slight	Slight	Moderate: slope.	Slight.
81C*:				
Vebar	Slight	Slight	Severe: slope.	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
81C*:				
Parshall	Slight	Slight	Severe: slope.	Slight.
81D Vebar	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
82D Vebar	Severe: large stones.	Severe: large stones.	Severe: large stones, slope.	Slight.
83E Baahish	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
84, 84B Hidatsa	Slight	Slight	Moderate: slope.	Slight.
86F*:				
Brandenburg	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope, small stones.	Severe: slope.
Cabba	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, erodes easily.
87F Lakoa	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
88, 88B Williams	Slight	Slight	Moderate: slope.	Slight.
88C Williams	Slight	Slight	Severe: slope.	Slight.
90C Williams	Slight	Slight	Moderate: large stones, slope.	Slight.
91B*:				
Williams	Slight	Slight	Moderate: slope.	Slight.
Noonan	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
91C*:				
Williams	Slight	Slight	Severe: slope.	Slight.
Noonan	Severe: excess sodium.	Severe: excess sodium.	Severe: slope, excess sodium.	Slight.
93C*:				
Williams	Slight	Slight	Severe: slope.	Slight.
Zahl	Slight	Slight	Severe: slope.	Slight.
93D*:				
Zahl	Slight	Slight	Severe: slope.	Slight.
Williams	Slight	Slight	Severe: slope.	Slight.

See footnote at end of table.

TABLE 8.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
93E*:				
Zahl	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
Williams	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
94B Moreau Variant	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Slight.
94E Wayden	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Moderate: too clayey, slope.
101B Amor	Slight	Slight	Moderate: slope, depth to rock.	Slight.
101C Amor	Slight	Slight	Severe: slope.	Slight.
102, 102B Shambo	Slight	Slight	Moderate: slope.	Slight.
105 Harriet	Severe: flooding, wetness, percs slowly.	Severe: wetness, excess sodium, percs slowly.	Severe: wetness, percs slowly, excess sodium.	Severe: wetness, erodes easily.
106B Daglum	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
107*. Aquents				
109B Ekalaka	Severe: excess sodium.	Severe: excess sodium.	Severe: excess sodium.	Slight.
207F Arikara	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
209E*:				
Cherry	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.
Cabba	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: erodes easily.
211F*: Badland.				
Cabba	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, erodes easily.
Arikara	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--WILDLIFE HABITAT

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
3------------------ Straw	Very poor	Very poor	Good	Good	Good	Good	Poor	Good	Good.
4------------------ Arnegard	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
4B----------------- Arnegard	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
5------------------ Tonka	Poor	Poor	Fair	Poor	Good	Good	Poor	Good	Poor.
7*:									
Straw--------------	Good	Good	Good	Good	Good	Good	Good	Good	Good.
Rhoades------------	Poor	Poor	Poor	Very poor	Poor	Poor	Poor	Poor	Very poor.
8C*:									
Cabba--------------	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Chama--------------	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
9D*:									
Amor---------------	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Cabba--------------	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
9E----------------- Cabba	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
10D---------------- Cabba	Very poor	Very poor	Fair	Fair	Poor	Very poor	Poor	Very poor	Fair.
11F*:									
Cabba--------------	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
Badland.									
12----------------- Banks	Poor	Fair	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
13D---------------- Wabek	Very poor	Poor	Poor	Poor	Very poor	Very poor	Poor	Very poor	Poor.
15*:									
Belfield-----------	Fair	Good	Fair	Poor	Poor	Very poor	Fair	Very poor	Fair.
Farland------------	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
16B*:									
Belfield-----------	Fair	Good	Fair	Poor	Poor	Very poor	Fair	Very poor	Fair.
Savage.									
18*:									
Belfield-----------	Fair	Good	Fair	Poor	Poor	Very poor	Fair	Very poor	Fair.
Grail--------------	Good	Good	Fair	Good	Very poor	Very poor	Good	Very poor	Fair.
19B*:									
Belfield-----------	Fair	Good	Fair	Poor	Poor	Very poor	Fair	Very poor	Fair.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
19B*:									
Morton	Good	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
21B, 21C Cherry	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
22 Colvin	Poor	Fair	Poor	Fair	Good	Good	Poor	Good	Poor.
24 Dimmick	Very poor	Poor	Poor	Poor	Good	Good	Very poor	Good	Poor.
25F*:									
Baahish	Very poor	Poor	Fair	Poor	Very poor	Very poor	Poor	Very poor	Poor.
Rock outcrop.									
27, 27B Farland	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
29B*:									
Farland	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
Rhoades	Poor	Poor	Poor	Very poor	Poor	Poor	Poor	Poor	Very poor.
30E*:									
Cohagen	Very poor	Very poor	Fair	Poor	Very poor	Very poor	Poor	Very poor	Poor.
Vebar	Very poor	Poor	Good	Very poor	Very poor	Very poor	Poor	Very poor	Good.
31F*:									
Cohagen	Very poor	Very poor	Fair	Poor	Very poor	Very poor	Poor	Very poor	Poor.
Vebar	Very poor	Poor	Good	Very poor	Very poor	Very poor	Poor	Very poor	Good.
Rock outcrop.									
32B*:									
Flaxton	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Williams	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
32C*:									
Flaxton	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Williams	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
33, 33B Grail	Good	Good	Fair	Good	Very poor	Very poor	Good	Very poor	Fair.
35 Lawther	Good	Good	Poor	Poor	Poor	Poor	Fair	Poor	Poor.
35B Lawther	Fair	Fair	Poor	Poor	Poor	Very poor	Fair	Very poor	Poor.
37 Trembles Variant	Very poor	Very poor	Fair	Fair	Good	Poor	Fair	Fair	Fair.
39, 40 Havrelon	Good	Good	Fair	Good	Poor	Very poor	Good	Very poor	Fair.
41 Heil	Poor	Poor	Fair	Very poor	Good	Good	Poor	Good	Poor.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Wetland wildlife	Rangeland wildlife
42B, 42C Lefor	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
43B Havrelon	Good	Good	Fair	Good	Poor	Very poor	Good	Very poor	Fair.
44B Lihen	Fair	Fair	Good	Good	Very poor	Very poor	Fair	Very poor	Good.
44D Lihen	Poor	Fair	Good	Good	Very poor	Very poor	Fair	Very poor	Good.
45B, 45C Ruso	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
46, 46B Bowdle	Fair	Fair	Good	Fair	Very poor	Very poor	Fair	Very poor	Fair.
47, 47B Moreau	Fair	Good	Poor	Poor	Poor	Very poor	Fair	Very poor	Poor.
47C Moreau	Fair	Fair	Poor	Poor	Poor	Very poor	Fair	Very poor	Poor.
48B Temvik	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
49, 49B Morton	Good	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
49C Morton	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
51C Amor	Poor	Very poor	Good	Fair	Poor	Very poor	Poor	Very poor	Fair.
52B*:									
Morton	Good	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
Rhoades	Poor	Poor	Poor	Very poor	Poor	Poor	Poor	Poor	Very poor.
52C*:									
Morton	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
Rhoades	Poor	Poor	Poor	Very poor	Poor	Poor	Poor	Poor	Very poor.
53B Watrous	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
54B Parshall	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
55*. Pits									
58, 58B, 58C Regent	Fair	Good	Fair	Poor	Poor	Very poor	Fair	Very poor	Poor.
61B*, 61C*:									
Regent	Fair	Good	Fair	Poor	Poor	Very poor	Fair	Very poor	Poor.
Rhoades	Poor	Poor	Poor	Very poor	Poor	Poor	Poor	Poor	Very poor.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herba- ceous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Wetland wildlife	Rangeland wildlife
62B----------------- Rhoades	Poor	Poor	Poor	Very poor	Poor	Poor	Poor	Poor	Very poor.
62D*:									
Rhoades------------	Poor	Poor	Poor	Very poor	Poor	Poor	Poor	Poor	Very poor.
Cabba--------------	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
64*. Badland									
67, 67B------------ Savage	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
68----------------- Vanda	Poor	Fair	Very poor	Very poor	Poor	Very poor	Poor	Very poor	Very poor.
69B*:									
Savage-------------	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
Rhoades------------	Poor	Poor	Poor	Very poor	Poor	Poor	Poor	Poor	Very poor.
70C---------------- Searing	Fair	Fair	Good	Fair	Very poor	Very poor	Fair	Very poor	Fair.
71B, 71C----------- Sen	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
73C*:									
Cherry-------------	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
Vanda--------------	Poor	Fair	Very poor	Very poor	Poor	Very poor	Poor	Very poor	Very poor.
75----------------- Straw	Good	Good	Good	Good	Good	Good	Good	Good	Good.
79----------------- Velva	Fair	Good	Fair	Good	Poor	Very poor	Fair	Very poor	Fair.
81B*, 81C*:									
Vebar--------------	Fair	Good	Good	Very poor	Poor	Very poor	Good	Very poor	Good.
Parshall-----------	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
81D---------------- Vebar	Poor	Fair	Good	Very poor	Very poor	Very poor	Fair	Very poor	Good.
82D---------------- Vebar	Poor	Fair	Good	Very poor	Very poor	Very poor	Fair	Very poor	Good.
83E---------------- Baahish	Very poor	Poor	Fair	Poor	Very poor	Very poor	Poor	Very poor	Poor.
84, 84B------------ Hidatsa	Fair	Fair	Good	Fair	Very poor	Very poor	Fair	Very poor	Fair.
86F*:									
Brandenburg--------	Very poor	Very poor	Fair	Poor	Very poor	Very poor	Poor	Very poor	Poor.
Cabba--------------	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
87F---------------- Lakoa	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Wetland wildlife	Rangeland wildlife
88, 88B------------ Williams	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
88C---------------- Williams	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
90C---------------- Williams	Poor	Poor	Good	Fair	Poor	Very poor	Poor	Very poor	Fair.
91B*:									
Williams----------	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Noonan------------	Poor	Poor	Very poor	Very poor	Poor	Very poor	Poor	Very poor	Very poor.
91C*:									
Williams----------	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Noonan------------	Poor	Poor	Very poor	Very poor	Poor	Very poor	Poor	Very poor	Very poor.
93C*:									
Williams----------	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Zahl--------------	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
93D*:									
Zahl--------------	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Williams----------	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
93E*:									
Zahl--------------	Poor	Fair	Good	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Williams----------	Poor	Fair	Good	Fair	Very poor	Very poor	Fair	Very poor	Fair.
94B---------------- Moreau Variant	Poor	Fair	Poor	Fair	Very poor	Very poor	Poor	Very poor	Poor.
94E---------------- Wayden	Very poor	Very poor	Poor	Fair	Very poor	Very poor	Very poor	Very poor	Poor.
101B, 101C--------- Amor	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
102, 102B---------- Shambo	Good	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
105---------------- Harriet	Poor	Poor	Fair	Very poor	Good	Good	Poor	Good	Poor.
106B--------------- Daglum	Fair	Good	Fair	Very poor	Poor	Very poor	Fair	Very poor	Poor.
107*. Aquents									
109B--------------- Ekalaka	Fair	Good	Poor	Fair	Poor	Very poor	Fair	Very poor	Poor.
207F--------------- Arikara	Very poor	Very poor	Fair	Good	Very poor	Very poor	Poor	Very poor	Fair.
209E*:									
Cherry------------	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.

See footnote at end of table.

TABLE 9.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
209E*:									
Cabba	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
211F*:									
Badland.									
Cabba	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
Arikara	Very poor	Very poor	Fair	Good	Very poor	Very poor	Poor	Very poor	Fair.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
3: Straw	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
4: Arnegard	Severe: cutbanks cave.	Moderate: shrink-swell.	Slight	Moderate: shrink-swell.	Severe: low strength.
4B: Arnegard	Severe: cutbanks cave.	Moderate: shrink-swell.	Slight	Moderate: shrink-swell, slope.	Severe: low strength.
5: Tonka	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, frost action.
7*:					
Straw	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
Rhoades	Moderate: too clayey, flooding.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: flooding, shrink-swell.	Severe: low strength, flooding, shrink-swell.
8C*:					
Cabba	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Moderate: depth to rock, frost action.
Chama	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
9D*:					
Amor	Moderate: depth to rock, slope.	Moderate: shrink-swell, slope.	Moderate: depth to rock, slope, shrink-swell.	Severe: slope.	Moderate: low strength, slope, frost action.
Cabba	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, slope, frost action.
9E: Cabba	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.
10D: Cabba	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, slope, frost action.
11F*:					
Cabba	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.
Badland.					
12: Banks	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
13D---------------- Wabek	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
15*:					
Belfield----------	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Farland-----------	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
16B*:					
Belfield----------	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Savage------------	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
18*:					
Belfield----------	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Grail-------------	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
19B*:					
Belfield----------	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Morton------------	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
21B---------------- Cherry	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
21C---------------- Cherry	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
22----------------- Colvin	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: low strength, wetness, flooding.
24----------------- Dimmick	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, shrink-swell.
25F*:					
Baahish-----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Rock outcrop.					
27----------------- Farland	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
27B---------------- Farland	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
29B*:					
Farland	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
Rhoades	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
30E*:					
Cohagen	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.
Vebar	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
31F*:					
Cohagen	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.
Vebar	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Rock outcrop.					
32B*:					
Flaxton	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
Williams	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
32C*:					
Flaxton	Severe: cutbanks cave.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
Williams	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
33 Grail	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
33B Grail	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
35, 35B Lawther	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
37 Trembles Variant	Severe: ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: flooding, ponding.	Severe: ponding, flooding.
39, 40 Havrelon	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.
41 Heil	Severe: ponding.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: ponding, shrink-swell.	Severe: low strength, ponding, shrink-swell.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
42B: Lefor	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell.	Moderate: frost action, shrink-swell.
42C: Lefor	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope.	Moderate: frost action, shrink-swell.
43B: Havrelon	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.
44B: Lihen	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
44D: Lihen	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
45B: Ruso	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
45C: Ruso	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
46: Bowdle	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
46B: Bowdle	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
47, 47B, 47C: Moreau	Moderate: depth to rock, too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
48B: Temvik	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: low strength, frost action.
49: Morton	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
49B, 49C: Morton	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
51C: Amor	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
52B*:					
Morton	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell.	Severe: low strength
Rhoades	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
52C*:					
Morton	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
Rhoades	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
53B---------------- Watrous	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: depth to rock.	Moderate: shrink-swell, depth to rock.	Severe: low strength.
54B---------------- Parshall	Severe: cutbanks cave.	Slight-----------	Slight-----------	Slight------------	Moderate: frost action.
55*. Pits					
58, 58B, 58C------ Regent	Moderate: depth to rock, too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
61B*, 61C*:					
Regent------------	Moderate: depth to rock, too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Rhoades-----------	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
62B---------------- Rhoades	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
62D*:					
Rhoades-----------	Moderate: too clayey, slope.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, shrink-swell.
Cabba-------------	Severe: depth to rock.	Moderate: shrink-swell, slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Moderate: depth to rock, slope, frost action.
64*. Badland					
67, 67B----------- Savage	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
68----------------- Vanda	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
69B*:					
Savage------------	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
Rhoades-----------	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
70C---------------- Searing	Moderate: large stones.	Moderate: large stones.	Moderate: large stones.	Moderate: slope, large stones.	Moderate: frost action, large stones.
71B, 71C---------- Sen	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
73C*:					
Cherry	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
Vanda	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
75 Straw	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
79 Velva	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
81B*:					
Vebar	Severe: cutbanks cave.	Slight	Moderate: depth to rock.	Slight	Slight.
Parshall	Severe: cutbanks cave.	Slight	Slight	Slight	Moderate: frost action.
81C*:					
Vebar	Severe: cutbanks cave.	Slight	Moderate: depth to rock.	Moderate: slope.	Slight.
Parshall	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Moderate: frost action.
81D Vebar	Severe: cutbanks cave.	Moderate: slope.	Moderate: depth to rock, slope.	Severe: slope.	Moderate: slope.
82D Vebar	Moderate: depth to rock, slope.	Moderate: slope.	Moderate: depth to rock, slope.	Severe: slope.	Moderate: slope.
83E Baahish	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
84 Hidatsa	Moderate: dense layer.	Slight	Slight	Slight	Slight.
84B Hidatsa	Moderate: dense layer.	Slight	Slight	Moderate: slope.	Slight.
86F*:					
Brandenburg	Severe: large stones, slope.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.	Severe: slope, large stones.
Cabba	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.
87F Lakoa	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope, low strength.
88 Williams	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
88B, 88C, 90C Williams	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
91B*, 91C*:					
Williams	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
Noonan	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
93C*:					
Williams	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
Zahl	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
93D*:					
Zahl	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
Williams	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
93E*:					
Zahl	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.
Williams	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: low strength, slope.
94B Moreau Variant	Severe: depth to rock.	Severe: shrink-swell.	Severe: depth to rock, shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
94E Wayden	Severe: depth to rock, slope.	Severe: shrink-swell, slope.	Severe: depth to rock, slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: low strength, slope, shrink-swell.
101B, 101C Amor	Moderate: depth to rock.	Moderate: shrink-swell.	Moderate: depth to rock, shrink-swell.	Moderate: shrink-swell, slope.	Moderate: low strength, frost action.
102 Shambo	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: low strength, frost action.
102B Shambo	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: low strength, frost action.
105 Harriet	Severe: wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding, frost action.
106B Daglum	Moderate: too clayey.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: shrink-swell.	Severe: low strength, shrink-swell.
107*. Aquents					

See footnote at end of table.

TABLE 10.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
109B--------------- Ekalaka	Severe: cutbanks cave.	Slight-----------	Slight-----------	Slight------------	Moderate: frost action.
207F--------------- Arikara	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
209E*: Cherry-----------	Moderate: too clayey, slope.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, slope.	Severe: slope.	Severe: low strength.
Cabba------------	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.
211F*: Badland.					
Cabba------------	Severe: depth to rock, slope.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.	Severe: slope.
Arikara----------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
3----------------- Straw	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage.	Severe: flooding.	Fair: too clayey.
4, 4B----------- Arnegard	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey, too sandy.	Slight----------	Fair: too clayey, too sandy.
5----------------- Tonka	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
7*:					
Straw------------	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage.	Severe: flooding.	Fair: too clayey.
Rhoades----------	Severe: flooding, percs slowly.	Severe: flooding.	Severe: flooding, too clayey, excess sodium.	Severe: flooding.	Poor: too clayey, hard to pack, excess sodium.
8C*:					
Cabba------------	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
Chama------------	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
9D*:					
Amor-------------	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
Cabba------------	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
9E---------------- Cabba	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope.
10D--------------- Cabba	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim, small stones.
11F*:					
Cabba------------	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope.
Badland.					
12---------------- Banks	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, too sandy.	Severe: flooding, seepage.	Poor: seepage, too sandy.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
13D: Wabek	Severe: poor filter.	Severe: seepage, slope.	Severe: too sandy, seepage.	Severe: seepage.	Poor: too sandy, seepage, small stones.
15*: Belfield	Severe: percs slowly.	Moderate: slope.	Severe: too clayey, excess sodium.	Slight	Poor: too clayey, hard to pack, excess sodium.
Farland	Moderate: percs slowly.	Moderate: seepage, slope.	Severe: too clayey, too sandy.	Slight	Poor: too clayey.
16B*: Belfield	Severe: percs slowly.	Moderate: slope.	Severe: too clayey, excess sodium.	Slight	Poor: too clayey, hard to pack, excess sodium.
Savage	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey.
18*: Belfield	Severe: percs slowly.	Moderate: slope.	Severe: too clayey, excess sodium.	Slight	Poor: too clayey, hard to pack, excess sodium.
Grail	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
19B*: Belfield	Severe: percs slowly.	Moderate: slope.	Severe: too clayey, excess sodium.	Slight	Poor: too clayey, hard to pack, excess sodium.
Morton	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
21B: Cherry	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
21C: Cherry	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
22: Colvin	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Poor: wetness.
24: Dimmick	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
25F*: Baahish	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: small stones, slope.
Rock outcrop.					

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
27, 27B------------- Farland	Moderate: percs slowly.	Moderate: seepage, slope.	Severe: too clayey, too sandy.	Slight-----------	Poor: too clayey.
29B*:					
Farland------------	Moderate: percs slowly.	Moderate: seepage, slope.	Severe: too clayey, too sandy.	Slight-----------	Poor: too clayey.
Rhoades------------	Severe: percs slowly.	Moderate: depth to rock, slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock.	Poor: too clayey, hard to pack.
30E*:					
Cohagen------------	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, seepage, slope.	Poor: area reclaim, slope.
Vebar--------------	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: area reclaim, slope.
31F*:					
Cohagen------------	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, seepage, slope.	Poor: area reclaim, slope.
Vebar--------------	Severe: depth to rock, slope.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Poor: area reclaim, slope.
Rock outcrop.					
32B*:					
Flaxton------------	Severe: percs slowly.	Severe: seepage.	Moderate: too clayey.	Severe: seepage.	Fair: too clayey.
Williams-----------	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
32C*:					
Flaxton------------	Severe: percs slowly.	Severe: seepage, slope.	Moderate: too clayey.	Severe: seepage.	Fair: too clayey.
Williams-----------	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
33, 33B------------- Grail	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack.
35, 35B------------- Lawther	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack.
37------------------ Trembles Variant	Severe: flooding, ponding.	Severe: seepage, flooding, ponding.	Severe: flooding, seepage, ponding.	Severe: flooding, seepage, ponding.	Poor: ponding.
39, 40-------------- Havrelon	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
41 Heil	Severe: ponding, percs slowly.	Severe: ponding.	Severe: ponding, too clayey, excess sodium.	Severe: ponding.	Poor: too clayey, hard to pack, ponding.
42B Lefor	Severe: depth to rock.	Severe: seepage, depth to rock.	Severe: depth to rock.	Severe: depth to rock, seepage.	Poor: area reclaim.
42C Lefor	Severe: depth to rock.	Severe: seepage, depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock, seepage.	Poor: area reclaim.
43B Havrelon	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
44B Lihen	Severe: poor filter.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too sandy.
44D Lihen	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: too sandy, slope.
45B Ruso	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
45C Ruso	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
46, 46B Bowdle	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: too sandy, seepage, small stones.
47, 47B Moreau	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
47C Moreau	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
48B Temvik	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
49, 49B Morton	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
49C Morton	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
51C Amor	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
52B*:					
Morton	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
52B*:					
Rhoades	Severe: percs slowly.	Moderate: depth to rock, slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock.	Poor: too clayey, hard to pack.
52C*:					
Morton	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
Rhoades	Severe: percs slowly.	Severe: slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock.	Poor: too clayey, hard to pack.
53B Watrous	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
54B Parshall	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too sandy.
55*. Pits					
58, 58B Regent	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
58C Regent	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
61B*:					
Regent	Severe: depth to rock, percs slowly.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
Rhoades	Severe: percs slowly.	Moderate: depth to rock, slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock.	Poor: too clayey, hard to pack.
61C*:					
Regent	Severe: depth to rock, percs slowly.	Severe: depth to rock, slope.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
Rhoades	Severe: percs slowly.	Severe: slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock.	Poor: too clayey, hard to pack.
62B Rhoades	Severe: percs slowly.	Moderate: depth to rock, slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock.	Poor: too clayey, hard to pack.
62D*:					
Rhoades	Severe: percs slowly.	Severe: slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock, slope.	Poor: too clayey, hard to pack.
Cabba	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
64*. Badland					

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
67, 67B----------- Savage	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight-----------	Poor: too clayey.
68----------------- Vanda	Severe: percs slowly.	Moderate: slope.	Slight-----------	Slight-----------	Poor: hard to pack.
69B*:					
Savage-------------	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight-----------	Poor: too clayey.
Rhoades------------	Severe: percs slowly.	Moderate: depth to rock, slope.	Severe: depth to rock, too clayey.	Moderate: depth to rock.	Poor: too clayey, hard to pack.
70C---------------- Searing	Severe: poor filter.	Severe: seepage.	Severe: seepage, large stones.	Severe: seepage.	Poor: seepage, small stones.
71B---------------- Sen	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
71C---------------- Sen	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
73C*:					
Cherry-------------	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight-----------	Poor: too clayey, hard to pack.
Vanda--------------	Severe: percs slowly.	Moderate: slope.	Slight-----------	Slight-----------	Poor: hard to pack.
75----------------- Straw	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage.	Severe: flooding.	Fair: too clayey.
79----------------- Velva	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage.	Severe: flooding, seepage.	Good.
81B*:					
Vebar--------------	Severe: depth to rock.	Severe: seepage, depth to rock.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: area reclaim.
Parshall-----------	Slight-----------	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too sandy.
81C*:					
Vebar--------------	Severe: depth to rock.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: area reclaim.
Parshall-----------	Slight-----------	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Fair: too sandy.
81D, 82D----------- Vebar	Severe: depth to rock.	Severe: seepage, depth to rock, slope.	Severe: depth to rock, seepage.	Severe: depth to rock, seepage.	Poor: area reclaim.
83E---------------- Baahish	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: small stones, slope.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
84, 84B------------- Hidatsa	Severe: poor filter.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: small stones.
86F*:					
Brandenburg--------	Severe: poor filter, slope, large stones.	Severe: seepage, slope, large stones.	Severe: seepage, slope, large stones.	Severe: seepage, slope.	Poor: seepage, small stones, slope.
Cabba--------------	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope.
87F---------------- Lakoa	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
88, 88B------------- Williams	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
88C---------------- Williams	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
90C---------------- Williams	Severe: percs slowly.	Moderate: seepage, slope, large stones.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
91B*:					
Williams-----------	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
Noonan-------------	Severe: percs slowly.	Moderate: slope.	Severe: excess sodium.	Slight-----------	Poor: excess sodium.
91C*:					
Williams-----------	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
Noonan-------------	Severe: percs slowly.	Severe: slope.	Severe: excess sodium.	Slight-----------	Poor: excess sodium.
93C*:					
Williams-----------	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
Zahl---------------	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
93D*:					
Zahl---------------	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
Williams-----------	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
93E*:					
Zahl---------------	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
Williams-----------	Severe: percs slowly, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.

See footnote at end of table.

TABLE 11.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
94B----------------- Moreau Variant	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock, too clayey.	Severe: depth to rock.	Poor: area reclaim, too clayey, hard to pack.
94E----------------- Wayden	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope, too clayey.	Severe: depth to rock, slope.	Poor: area reclaim, too clayey, hard to pack.
101B---------------- Amor	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
101C---------------- Amor	Severe: depth to rock.	Severe: depth to rock, slope.	Severe: depth to rock.	Severe: depth to rock.	Poor: area reclaim.
102, 102B----------- Shambo	Moderate: percs slowly.	Severe: seepage.	Severe: seepage.	Slight-----------	Fair: too clayey.
105----------------- Harriet	Severe: flooding, wetness, percs slowly.	Severe: flooding, wetness.	Severe: flooding, wetness, too clayey.	Severe: flooding, wetness.	Poor: too clayey, wetness, excess sodium.
106B---------------- Daglum	Severe: percs slowly.	Moderate: depth to rock, slope.	Severe: depth to rock, too clayey, excess sodium.	Moderate: depth to rock.	Poor: too clayey, excess sodium.
107*. Aquents					
109B---------------- Ekalaka	Severe: percs slowly.	Severe: seepage.	Severe: seepage, too sandy, excess sodium.	Severe: seepage.	Poor: too sandy, excess sodium.
207F---------------- Arikara	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.
209E*:					
Cherry--------------	Severe: percs slowly.	Severe: slope.	Severe: too clayey.	Moderate: slope.	Poor: too clayey, hard to pack.
Cabba---------------	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope.
211F*:					
Badland.					
Cabba---------------	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Poor: area reclaim, slope.
Arikara-------------	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Poor: slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--CONSTRUCTION MATERIALS

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," "poor," "probable," and "improbable." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
3 Straw	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
4, 4B Arnegard	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
5 Tonka	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer, wetness.
7*:				
Straw	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
Rhoades	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
8C*:				
Cabba	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
Chama	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, thin layer.
9D*:				
Amor	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, thin layer, slope.
Cabba	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
9E Cabba	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
10D Cabba	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
11F*:				
Cabba	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
Badland.				
12 Banks	Good	Probable	Improbable: too sandy.	Fair: too sandy.
13D Wabek	Good	Probable	Probable	Poor: small stones, area reclaim.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
15*:				
Belfield	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
Farland	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
16B*:				
Belfield	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
Savage	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
18*:				
Belfield	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
Grail	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
19B*:				
Belfield	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
Morton	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, thin layer.
21B, 21C Cherry	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
22 Colvin	Poor: low strength, wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt, wetness.
24 Dimmick	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey, wetness.
25F*:				
Baahish	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
Rock outcrop.				
27, 27B Farland	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
29B*:				
Farland	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: thin layer.
Rhoades	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
30E*:				
Cohagen	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
Vebar	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
31F*:				
Cohagen	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
Vebar	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Rock outcrop.				
32B*, 32C*:				
Flaxton	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Williams	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: large stones.
33, 33B Grail	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
35, 35B Lawther	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
37 Trembles Variant	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness.
39, 40 Havrelon	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
41 Heil	Poor: low strength, wetness, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, excess sodium.
42B, 42C Lefor	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, thin layer.
43B Havrelon	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
44B, 44D Lihen	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy, small stones.
45B, 45C Ruso	Good	Probable	Probable	Poor: small stones, area reclaim.
46, 46B Bowdle	Good	Probable	Probable	Fair: area reclaim.
47, 47B, 47C Moreau	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
48B------------------- Temvik	Fair: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Good.
49, 49B, 49C---------- Morton	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, thin layer.
51C------------------- Amor	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, large stones.
52B*, 52C*:				
Morton---------------	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, thin layer.
Rhoades--------------	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
53B------------------- Watrous	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones, thin layer.
54B------------------- Parshall	Good-----------------	Improbable: excess fines.	Improbable: excess fines.	Good.
55*. Pits				
58, 58B, 58C---------- Regent	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
61B*, 61C*:				
Regent---------------	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Rhoades--------------	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
62B------------------- Rhoades	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
62D*:				
Rhoades--------------	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
Cabba----------------	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones.
64*. Badland				
67, 67B--------------- Savage	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
68-------------------- Vanda	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt, too clayey.
69B*:				
Savage---------------	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: thin layer.
Rhoades--------------	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
70C------------------ Searing	Fair: large stones.	Improbable: small stones, large stones.	Improbable: large stones.	Poor: small stones, area reclaim.
71B, 71C------------- Sen	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, thin layer.
73C*:				
Cherry---------------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Vanda----------------	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt, too clayey.
75------------------- Straw	Good-----------------	Improbable: excess fines.	Improbable: excess fines.	Good.
79------------------- Velva	Good-----------------	Improbable: excess fines.	Improbable: excess fines.	Good.
81B*, 81C*:				
Vebar----------------	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, thin layer.
Parshall-------------	Good-----------------	Improbable: excess fines.	Improbable: excess fines.	Good.
81D, 82D------------- Vebar	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, thin layer, slope.
83E------------------ Baahish	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
84, 84B-------------- Hidatsa	Good-----------------	Improbable: excess fines.	Improbable: excess fines.	Poor: small stones, area reclaim.
86F*:				
Brandenburg----------	Poor: large stones, slope.	Improbable: small stones, large stones.	Improbable: large stones.	Poor: small stones, area reclaim, slope.
Cabba----------------	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
87F Lakoa	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
88, 88B, 88C, 90C Williams	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: large stones.
91B*, 91C*:				
Williams	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: large stones.
Noonan	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
93C*:				
Williams	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: large stones.
Zahl	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
93D*:				
Zahl	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: small stones.
Williams	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: large stones.
93E*:				
Zahl	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Williams	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
94B Moreau Variant	Poor: area reclaim, low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
94E Wayden	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, too clayey, slope.
101B, 101C Amor	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, thin layer.
102, 102B Shambo	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
105 Harriet	Poor: wetness.	Improbable: excess fines.	Improbable: excess fines.	Poor: wetness, excess sodium.
106B Daglum	Poor: low strength, shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
107*. Aquents				
109B Ekalaka	Good	Improbable: excess fines.	Improbable: excess fines.	Poor: excess sodium.
207F Arikara	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.

See footnote at end of table.

TABLE 12.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
209E*:				
Cherry----------------	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, slope.
Cabba-----------------	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
211F*:				
Badland.				
Cabba-----------------	Poor: area reclaim, slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, slope.
Arikara---------------	Poor: slope.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
3 Straw	Moderate: seepage.	Severe: piping.	Deep to water	Flooding	Favorable	Favorable.
4 Arnegard	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Favorable	Favorable.
4B Arnegard	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope	Favorable	Favorable.
5 Tonka	Slight	Severe: ponding.	Ponding, percs slowly, frost action.	Ponding, percs slowly.	Erodes easily, ponding, percs slowly.	Wetness, erodes easily, percs slowly.
7*:						
Straw	Moderate: seepage.	Severe: piping.	Deep to water	Flooding	Favorable	Favorable.
Rhoades	Slight	Severe: hard to pack, excess sodium.	Deep to water	Percs slowly, flooding, excess sodium.	Percs slowly	Excess sodium, percs slowly.
8C*:						
Cabba	Severe: depth to rock.	Severe: piping.	Deep to water	Depth to rock, slope.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
Chama	Moderate: seepage, depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
9D*:						
Amor	Severe: slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, depth to rock.	Slope, depth to rock.
Cabba	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
9E Cabba	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
10D Cabba	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope, excess salt.	Slope, large stones, depth to rock.	Large stones, slope, depth to rock.
11F*:						
Cabba	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
Badland.						
12 Banks	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
13D Wabek	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, slope.	Slope, too sandy.	Slope, droughty.
15*:						
Belfield	Slight	Severe: excess sodium.	Deep to water	Percs slowly, excess sodium.	Percs slowly	Excess sodium, percs slowly.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
15*:						
Farland	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Favorable	Favorable.
16B*:						
Belfield	Moderate: slope.	Severe: excess sodium.	Deep to water	Percs slowly, slope, excess sodium.	Percs slowly	Excess sodium, percs slowly.
Savage	Moderate: slope.	Moderate: piping.	Deep to water	Percs slowly, slope, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
18*:						
Belfield	Slight	Severe: excess sodium.	Deep to water	Percs slowly, excess sodium.	Percs slowly	Excess sodium, percs slowly.
Grail	Slight	Moderate: piping, hard to pack.	Deep to water	Percs slowly	Percs slowly	Percs slowly.
19B*:						
Belfield	Moderate: slope.	Severe: excess sodium.	Deep to water	Percs slowly, slope, excess sodium.	Percs slowly	Excess sodium, percs slowly.
Morton	Moderate: seepage, depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
21B, 21C Cherry	Moderate: slope.	Moderate: piping, hard to pack.	Deep to water	Percs slowly, slope.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
22 Colvin	Moderate: seepage.	Severe: wetness.	Percs slowly, flooding, frost action.	Wetness, percs slowly, flooding.	Wetness, percs slowly.	Wetness, excess salt, percs slowly.
24 Dimmick	Slight	Severe: hard to pack, ponding.	Ponding, percs slowly.	Ponding, slow intake, percs slowly.	Ponding, percs slowly.	Wetness, percs slowly.
25F*:						
Baahish	Severe: seepage, slope.	Severe: seepage.	Deep to water	Large stones, droughty, rooting depth.	Slope, large stones.	Large stones, slope, droughty.
Rock outcrop.						
27 Farland	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Favorable	Favorable.
27B Farland	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope	Favorable	Favorable.
29B*:						
Farland	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope	Favorable	Favorable.
Rhoades	Moderate: depth to rock, slope.	Severe: excess sodium.	Deep to water	Percs slowly, slope.	Percs slowly	Excess sodium, percs slowly.
30E*:						
Cohagen	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Soil blowing, depth to rock, slope.	Slope, depth to rock, soil blowing.	Slope, depth to rock.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
30E*:						
Vebar	Severe: seepage, slope.	Severe: piping.	Deep to water	Soil blowing, depth to rock, slope.	Slope, depth to rock, soil blowing.	Slope, depth to rock.
31F*:						
Cohagen	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Soil blowing, depth to rock, slope.	Slope, depth to rock, soil blowing.	Slope, depth to rock.
Vebar	Severe: seepage, slope.	Severe: piping.	Deep to water	Soil blowing, depth to rock, slope.	Slope, depth to rock, soil blowing.	Slope, depth to rock.
Rock outcrop.						
32B*, 32C*:						
Flaxton	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing, slope.	Erodes easily, soil blowing.	Erodes easily.
Williams	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Percs slowly, slope.	Erodes easily	Erodes easily, percs slowly.
33 Grail	Slight	Moderate: piping, hard to pack.	Deep to water	Percs slowly	Percs slowly	Percs slowly.
33B Grail	Moderate: slope.	Moderate: piping, hard to pack.	Deep to water	Percs slowly, slope.	Percs slowly	Percs slowly.
35 Lawther	Slight	Moderate: hard to pack.	Deep to water	Slow intake, percs slowly.	Percs slowly	Excess salt, percs slowly.
35B Lawther	Moderate: slope.	Moderate: hard to pack.	Deep to water	Slow intake, percs slowly, slope.	Percs slowly	Excess salt, percs slowly.
37 Trembles Variant	Severe: seepage.	Severe: piping, ponding.	Ponding, flooding.	Ponding, soil blowing, flooding.	Ponding, soil blowing.	Wetness.
39, 40 Havrelon	Moderate: seepage.	Severe: piping.	Deep to water	Flooding	Favorable	Favorable.
41 Heil	Slight	Severe: hard to pack, ponding, excess sodium.	Ponding, percs slowly, excess salt.	Ponding, percs slowly.	Ponding, percs slowly.	Wetness, excess sodium, percs slowly.
42B, 42C Lefor	Moderate: seepage, depth to rock, slope.	Severe: thin layer.	Deep to water	Soil blowing, depth to rock, slope.	Depth to rock, soil blowing.	Depth to rock.
43B Havrelon	Moderate: seepage.	Severe: piping.	Deep to water	Flooding	Favorable	Favorable.
44B Lihen	Severe: seepage.	Severe: piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
44D Lihen	Severe: seepage, slope.	Severe: piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
45B, 45C Ruso	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, soil blowing, slope.	Too sandy, soil blowing.	Droughty.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
46 Bowdle	Severe: seepage.	Severe: seepage.	Deep to water	Favorable	Too sandy	Favorable.
46B Bowdle	Severe: seepage.	Severe: seepage.	Deep to water	Slope	Too sandy	Favorable.
47 Moreau	Moderate: depth to rock.	Severe: hard to pack.	Deep to water	Slow intake, percs slowly, depth to rock.	Depth to rock, percs slowly.	Depth to rock, percs slowly.
47B, 47C Moreau	Moderate: depth to rock, slope.	Severe: hard to pack.	Deep to water	Slow intake, percs slowly, depth to rock.	Depth to rock, percs slowly.	Depth to rock, percs slowly.
48B Temvik	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope	Erodes easily	Erodes easily.
49 Morton	Moderate: seepage, depth to rock.	Severe: piping.	Deep to water	Depth to rock	Depth to rock, erodes easily.	Erodes easily, depth to rock.
49B, 49C Morton	Moderate: seepage, depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
51C Amor	Moderate: seepage, depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Large stones, depth to rock.	Large stones, depth to rock.
52B*, 52C*:						
Morton	Moderate: seepage, depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
Rhoades	Moderate: depth to rock, slope.	Severe: excess sodium.	Deep to water	Percs slowly, slope.	Percs slowly	Excess sodium, percs slowly.
53B Watrous	Moderate: seepage, depth to rock, slope.	Severe: thin layer.	Deep to water	Depth to rock, slope.	Depth to rock	Depth to rock.
54B Parshall	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing, slope.	Too sandy, soil blowing.	Favorable.
55*. Pits						
58 Regent	Moderate: depth to rock.	Severe: hard to pack.	Deep to water	Percs slowly, depth to rock.	Depth to rock, percs slowly.	Depth to rock, percs slowly.
58B, 58C Regent	Moderate: depth to rock, slope.	Severe: hard to pack.	Deep to water	Percs slowly, depth to rock.	Depth to rock, percs slowly.	Depth to rock, percs slowly.
61B*, 61C*:						
Regent	Moderate: depth to rock, slope.	Severe: hard to pack.	Deep to water	Percs slowly, depth to rock.	Depth to rock, percs slowly.	Depth to rock, percs slowly.
Rhoades	Moderate: depth to rock, slope.	Severe: excess sodium.	Deep to water	Percs slowly, slope.	Percs slowly	Excess sodium, percs slowly.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
62B---------------- Rhoades	Moderate: depth to rock, slope.	Severe: excess sodium.	Deep to water	Percs slowly, slope.	Percs slowly---	Excess sodium, percs slowly.
62D*:						
Rhoades-----------	Severe: slope.	Severe: excess sodium.	Deep to water	Percs slowly, slope.	Slope, soil blowing, percs slowly.	Slope, excess sodium, percs slowly.
Cabba-------------	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
64*. Badland						
67----------------- Savage	Slight----------	Moderate: piping.	Deep to water	Percs slowly, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
67B---------------- Savage	Moderate: slope.	Moderate: piping.	Deep to water	Percs slowly, slope, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
68----------------- Vanda	Slight----------	Severe: hard to pack.	Deep to water	Droughty, slow intake, percs slowly.	Erodes easily, percs slowly.	Excess salt, erodes easily.
69B*:						
Savage------------	Moderate: slope.	Moderate: piping.	Deep to water	Percs slowly, slope, erodes easily.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
Rhoades-----------	Moderate: depth to rock, slope.	Severe: excess sodium.	Deep to water	Percs slowly, slope.	Percs slowly---	Excess sodium, percs slowly.
70C---------------- Searing	Severe: seepage.	Severe: seepage.	Deep to water	Large stones, slope.	Large stones---	Large stones.
71B, 71C----------- Sen	Moderate: seepage, depth to rock, slope.	Moderate: thin layer, piping.	Deep to water	Depth to rock, slope.	Depth to rock, erodes easily.	Erodes easily, depth to rock.
73C*:						
Cherry------------	Moderate: slope.	Moderate: piping, hard to pack.	Deep to water	Percs slowly, slope.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
Vanda-------------	Moderate: slope.	Severe: hard to pack.	Deep to water	Droughty, slow intake, percs slowly.	Erodes easily, percs slowly.	Excess salt, erodes easily.
75----------------- Straw	Moderate: seepage.	Severe: piping.	Deep to water	Flooding--------	Favorable-------	Favorable.
79----------------- Velva	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing, flooding.	Soil blowing---	Favorable.
81B*, 81C*:						
Vebar-------------	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing, depth to rock, slope.	Depth to rock, soil blowing.	Depth to rock.
Parshall----------	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing, slope.	Too sandy, soil blowing.	Favorable.
81D---------------- Vebar	Severe: seepage, slope.	Severe: piping.	Deep to water	Soil blowing, depth to rock, slope.	Slope, depth to rock, soil blowing.	Slope, depth to rock.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Features affecting-- Drainage	Features affecting-- Irrigation	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
82D----------------- Vebar	Severe: seepage, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, depth to rock.	Slope, depth to rock.
83E----------------- Baahish	Severe: seepage, slope.	Severe: seepage.	Deep to water	Large stones, droughty, rooting depth.	Slope, large stones.	Large stones, slope, droughty.
84----------------- Hidatsa	Severe: seepage.	Severe: seepage.	Deep to water	Rooting depth	Large stones---	Large stones, rooting depth.
84B----------------- Hidatsa	Severe: seepage.	Severe: seepage.	Deep to water	Rooting depth, slope.	Large stones---	Large stones, rooting depth.
86F*:						
Brandenburg-------	Severe: seepage, slope.	Severe: seepage, large stones.	Deep to water	Large stones, droughty, slope.	Slope, large stones.	Large stones, slope, droughty.
Cabba-------------	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
87F----------------- Lakoa	Severe: slope.	Moderate: piping.	Deep to water	Slope-----------	Slope-----------	Slope.
88----------------- Williams	Moderate: seepage.	Moderate: piping.	Deep to water	Percs slowly---	Erodes easily	Erodes easily, percs slowly.
88B, 88C----------- Williams	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Percs slowly, slope.	Erodes easily	Erodes easily, percs slowly.
90C----------------- Williams	Moderate: seepage, slope.	Moderate: piping, large stones.	Deep to water	Percs slowly, slope.	Large stones, percs slowly.	Large stones, percs slowly.
91B*, 91C*:						
Williams----------	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Percs slowly, slope.	Erodes easily	Erodes easily, percs slowly.
Noonan------------	Moderate: slope.	Severe: piping, excess sodium.	Deep to water	Percs slowly, slope, excess sodium.	Percs slowly---	Excess sodium, percs slowly.
93C*:						
Williams----------	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Percs slowly, slope.	Erodes easily	Erodes easily, percs slowly.
Zahl--------------	Moderate: slope.	Moderate: piping.	Deep to water	Percs slowly, slope.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
93D*:						
Zahl--------------	Moderate: slope.	Moderate: piping.	Deep to water	Percs slowly, slope.	Erodes easily, percs slowly.	Erodes easily, percs slowly.
Williams----------	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Percs slowly, slope.	Erodes easily	Erodes easily, percs slowly.
93E*:						
Zahl--------------	Severe: slope.	Moderate: piping.	Deep to water	Percs slowly, slope.	Slope, erodes easily, percs slowly.	Slope, erodes easily, percs slowly.
Williams----------	Severe: slope.	Moderate: piping.	Deep to water	Percs slowly, slope.	Slope, erodes easily.	Slope, erodes easily, percs slowly.

See footnote at end of table.

TABLE 13.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for--		Features affecting--			
	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Terraces and diversions	Grassed waterways
94B: Moreau Variant	Severe: depth to rock.	Severe: hard to pack.	Deep to water	Percs slowly, depth to rock, slope.	Depth to rock, percs slowly.	Excess salt, depth to rock, percs slowly.
94E: Wayden	Severe: depth to rock, slope.	Severe: thin layer.	Deep to water	Slow intake, percs slowly, depth to rock.	Slope, depth to rock, percs slowly.	Slope, excess salt, depth to rock.
101B, 101C: Amor	Moderate: seepage, depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Depth to rock	Depth to rock.
102: Shambo	Moderate: seepage.	Severe: piping.	Deep to water	Favorable	Favorable	Favorable.
102B: Shambo	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope	Favorable	Favorable.
105: Harriet	Slight	Severe: piping, wetness, excess sodium.	Percs slowly, flooding, frost action.	Wetness, percs slowly.	Erodes easily, wetness.	Wetness, excess sodium, erodes easily.
106B: Daglum	Moderate: depth to rock, slope.	Severe: excess sodium.	Deep to water	Percs slowly, slope.	Percs slowly	Excess sodium, percs slowly.
107*. Aquents						
109B: Ekalaka	Severe: seepage.	Severe: piping, excess sodium.	Deep to water	Droughty, soil blowing.	Too sandy, soil blowing.	Excess sodium, droughty.
207F: Arikara	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope	Slope.
209E*: Cherry	Severe: slope.	Moderate: piping, hard to pack.	Deep to water	Percs slowly, slope.	Slope, erodes easily, percs slowly.	Slope, erodes easily, percs slowly.
Cabba	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
211F*: Badland.						
Cabba	Severe: depth to rock, slope.	Severe: piping.	Deep to water	Depth to rock, slope.	Slope, depth to rock, erodes easily.	Slope, erodes easily, depth to rock.
Arikara	Severe: slope.	Severe: piping.	Deep to water	Slope	Slope	Slope.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--ENGINEERING INDEX PROPERTIES

[The symbol > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
3---------------- Straw	0-23	Loam, silt loam	CL-ML	A-4	0	100	100	85-100	60-90	20-30	5-10
	23-60	Loam, silt loam, clay loam.	ML, CL	A-4, A-6	0	100	100	85-100	65-85	30-40	5-15
4, 4B------------- Arnegard	0-10	Loam-------------	CL-ML, CL	A-4, A-6	0	100	100	85-100	60-90	20-35	5-20
	10-42	Loam, silt loam, clay loam.	CL	A-6	0	100	100	85-100	50-90	25-40	12-25
	42-60	Loam, clay loam, very fine sandy loam.	ML, CL	A-6	0	100	100	80-100	50-80	20-40	12-25
5---------------- Tonka	0-13	Silt loam, loam	CL, CL-ML	A-4, A-6	0-2	100	95-100	90-100	70-90	20-40	5-25
	13-36	Silty clay loam, silty clay, clay	CH, CL	A-6, A-7	0-2	100	95-100	90-100	75-95	35-55	15-35
	36-60	Silty clay loam, clay loam.	CL	A-6, A-7	0-3	100	95-100	90-100	70-90	30-50	10-30
7*:											
Straw------------	0-23	Loam, silt loam	CL-ML	A-4	0	100	100	85-100	60-90	20-30	5-10
	23-60	Loam, silt loam, clay loam.	ML, CL	A-4, A-6	0	100	100	85-100	65-85	30-40	5-15
Rhoades----------	0-3	Loam-------------	CL, CL-ML	A-4, A-6	0	100	100	85-100	60-90	20-30	5-15
	3-18	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	70-95	30-45	10-25
	18-60	Silty clay, clay.	CH, CL	A-7	0	100	100	95-100	90-95	40-70	20-45
8C*:											
Cabba------------	0-3	Silt loam--------	ML, CL-ML	A-4	0-5	90-100	85-100	70-90	60-80	20-30	**NP-10
	3-18	Gravelly loam, clay loam, silt loam.	GC, CL, SC, CL-ML	A-6, A-4	0-5	70-100	55-100	45-85	40-80	25-35	5-15
	18-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Chama------------	0-8	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	100	90-100	70-90	25-40	5-20
	8-30	Silt loam, silty clay loam.	ML, CL	A-4, A-6, A-7	0	100	100	90-100	70-90	30-60	5-25
	30-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
9D*:											
Amor-------------	0-7	Loam-------------	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	65-85	25-40	3-18
	7-34	Clay loam, loam, very fine sandy loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	75-100	50-80	20-45	2-25
	34-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Cabba------------	0-3	Loam-------------	ML, CL-ML	A-4	0-5	90-100	85-100	70-90	60-80	20-30	NP-10
	3-18	Gravelly loam, clay loam, silt loam.	GC, CL, SC, CL-ML	A-6, A-4	0-5	70-100	55-100	45-85	40-80	25-35	5-15
	18-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
9E--------------- Cabba	0-3	Loam-------------	ML, CL-ML	A-4	0-5	90-100	85-100	70-90	60-80	20-30	NP-10
	3-18	Gravelly loam, clay loam, silt loam.	GC, CL, SC, CL-ML	A-6, A-4	0-5	70-100	55-100	45-85	40-80	25-35	5-15
	18-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
10D-------------- Cabba	0-3	Extremely stony loam.	ML, CL-ML, SM, SM-SC	A-4	40-45	95-100	90-100	65-85	45-65	15-30	NP-10
	3-18	Gravelly loam, clay loam, silt loam.	CL, CL-ML, SM-SC, GM-GC	A-4, A-6	0-10	60-100	55-95	50-85	45-80	25-35	5-15
	18-60	Weathered bedrock	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
11F*:											
Cabba	0-3	Loam	ML, CL-ML	A-4	0-5	90-100	85-100	70-90	60-80	20-30	NP-10
	3-18	Gravelly loam, clay loam, silt loam.	GC, CL, SC, CL-ML	A-6, A-4	0-5	70-100	55-100	45-85	40-80	25-35	5-15
	18-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Badland.											
12	0-4	Loamy sand	SM, SP-SM	A-2, A-4	0	100	100	60-80	10-40	---	NP
Banks	4-60	Loamy fine sand, fine sand, sand.	SM, SP-SM	A-2	0	100	100	50-70	10-25	---	NP
13D	0-6	Gravelly loam	ML	A-4	0-1	90-100	90-100	75-90	50-70	25-40	NP-10
Wabek	6-11	Gravelly sandy loam, gravelly loam, gravelly coarse sandy loam.	SM, GM	A-2, A-4	0-1	50-100	50-95	50-65	20-40	---	NP
	11-60	Sand and gravel	GM, GP, SM, SP	A-1	0-1	25-75	10-60	5-35	0-25	---	NP
15*:											
Belfield	0-12	Silt loam	CL	A-6	0	100	100	85-100	60-90	20-40	10-25
	12-30	Silty clay, silty clay loam, clay loam.	CH, CL	A-7	0	100	100	90-100	70-95	40-65	15-40
	30-60	Silty clay, silty clay loam, clay loam.	CH, CL	A-7, A-6	0	100	100	90-100	70-95	30-55	10-30
Farland	0-8	Silt loam	CL, CL-ML	A-4, A-6	0	100	100	85-100	70-90	20-40	5-25
	8-18	Silty clay loam, clay loam.	CL, CH	A-7	0	100	100	90-100	75-95	40-60	15-35
	18-31	Loam, silt loam, silty clay loam.	CL, CL-ML	A-6, A-7, A-4	0	100	100	85-100	70-90	25-50	5-30
	31-60	Stratified very fine sand to silty clay.	CL, ML, CL-ML	A-4, A-6, A-7	0	100	100	75-100	50-95	20-50	3-25
16B*:											
Belfield	0-12	Silty clay loam	CL	A-7, A-6	0	100	100	90-100	70-95	30-50	10-30
	12-30	Silty clay, silty clay loam, clay loam.	CH, CL	A-7	0	100	100	90-100	70-95	40-65	15-40
	30-60	Silty clay, silty clay loam, clay loam.	CH, CL	A-7, A-6	0	100	100	90-100	70-95	30-55	10-30
Savage	0-5	Silty clay loam	CL, CL-ML	A-6, A-4	0	100	100	95-100	85-95	25-40	5-15
	5-13	Clay, silty clay, silty clay loam.	CL	A-7, A-6	0	100	100	90-100	80-95	35-50	15-30
	13-60	Silty clay, silty clay loam, clay.	CL	A-7, A-6	0	100	95-100	85-100	80-95	30-50	10-30
18*:											
Belfield	0-12	Silty clay loam	CL	A-7, A-6	0	100	100	90-100	70-95	30-50	10-30
	12-30	Silty clay, silty clay loam, clay loam.	CH, CL	A-7	0	100	100	90-100	70-95	40-65	15-40
	30-60	Silty clay, silty clay loam, clay loam.	CH, CL	A-7, A-6	0	100	100	90-100	70-95	30-55	10-30
Grail	0-11	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	85-95	30-45	10-30
	11-20	Silty clay, silty clay loam, clay.	CL, CH, ML	A-7, A-6	0	100	100	95-100	70-95	35-55	10-35
	20-60	Loam, silty clay loam, clay.	CL, CH	A-6, A-7	0	100	100	85-100	60-95	30-55	10-30

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
19B*:											
Belfield	0-12	Silt loam	CL	A-6	0	100	100	85-100	60-90	20-40	10-25
	12-30	Silty clay, silty clay loam, clay loam.	CH, CL	A-7	0	100	100	90-100	70-95	40-65	15-40
	30-60	Silty clay, silty clay loam, clay loam.	CH, CL	A-7, A-6	0	100	100	90-100	70-95	30-55	10-30
Morton	0-5	Silt loam	ML, CL, CL-ML	A-4, A-6	0	100	100	85-100	60-90	20-40	3-23
	5-27	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	95-100	85-95	25-50	10-30
	27-37	Loam, silt loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	95-100	75-95	20-50	3-30
	37-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
21B, 21C Cherry	0-4	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	85-95	35-45	15-25
	4-26	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	70-95	25-45	10-30
	26-60	Silty clay, silty clay loam, silt loam.	CL, CH	A-6, A-7	0	100	100	90-100	70-95	25-55	10-30
22 Colvin	0-14	Silt loam	CL	A-6	0	100	100	90-100	80-95	20-35	10-20
	14-60	Silt loam, silty clay loam, silty clay.	CL	A-6, A-7	0	100	100	90-100	80-95	20-50	10-30
24 Dimmick	0-20	Clay	CH, CL	A-7	0	100	100	90-100	75-95	40-60	15-35
	20-60	Clay, silty clay	CH, CL	A-7	0	100	100	90-100	75-95	45-70	20-45
25F*:											
Baahish	0-3	Fine sandy loam	CL, CL-ML	A-4, A-6	0-5	95-100	95-100	85-95	60-80	25-40	5-15
	3-13	Loam, fine sandy loam, sandy loam.	CL, CL-ML, SM-SC, SC	A-4, A-6, A-2	0-5	80-100	75-100	65-100	30-75	25-35	5-15
	13-60	Very gravelly sandy loam, very gravelly loam, very gravelly fine sandy loam.	GM, GM-GC, SM, SM-SC	A-1	10-40	40-65	25-55	15-45	10-30	<25	NP-5
Rock outcrop.											
27, 27B Farland	0-8	Silt loam	CL, CL-ML	A-4, A-6	0	100	100	85-100	70-90	20-40	5-25
	8-18	Silty clay loam, clay loam.	CL, CH	A-7	0	100	100	90-100	75-95	40-60	15-35
	18-31	Loam, silt loam, silty clay loam.	CL, CL-ML	A-6, A-7, A-4	0	100	100	85-100	70-90	25-50	5-30
	31-60	Stratified very fine sand to silty clay.	CL, ML, CL-ML	A-4, A-6, A-7	0	100	100	75-100	50-95	20-50	3-25
29B*:											
Farland	0-8	Silt loam	CL, CL-ML	A-4, A-6	0	100	100	85-100	70-90	20-40	5-25
	8-18	Silty clay loam, clay loam.	CL, CH	A-7	0	100	100	90-100	75-95	40-60	15-35
	18-31	Loam, silt loam, silty clay loam.	CL, CL-ML	A-6, A-7, A-4	0	100	100	85-100	70-90	25-50	5-30
	31-60	Stratified very fine sand to silty clay.	CL, ML, CL-ML	A-4, A-6, A-7	0	100	100	75-100	50-95	20-50	3-25
Rhoades	0-3	Silt loam	CL	A-6, A-7	0	100	100	90-100	70-85	30-45	10-25
	3-10	Clay loam, silty clay loam, clay.	CL, CH	A-7	0	100	100	90-100	80-95	40-75	20-45
	10-59	Silty clay, clay, loam.	CL, CH	A-6, A-7	0	100	100	85-100	75-95	35-70	20-40
	59-60	Weathered bedrock	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
30E*:											
Cohagen----------	0-15	Fine sandy loam	SM	A-2, A-4	0	100	95-100	60-85	30-50	---	NP
	15-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Vebar------------	0-23	Fine sandy loam	SM, ML	A-4, A-2	0	100	100	60-85	30-55	---	NP
	23-38	Very fine sandy loam, loamy fine sand, sandy loam	SM, ML	A-4, A-2	0	100	100	60-85	30-55	---	NP
	38-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
31F*:											
Cohagen----------	0-15	Fine sandy loam	SM	A-2, A-4	0	100	95-100	60-85	30-50	---	NP
	15-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Vebar------------	0-23	Fine sandy loam	SM, ML	A-4, A-2	0	100	100	60-85	30-55	---	NP
	23-38	Very fine sandy loam, loamy fine sand, sandy loam	SM, ML	A-4, A-2	0	100	100	60-85	30-55	---	NP
	38-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Rock outcrop.											
32B*, 32C*:											
Flaxton----------	0-12	Fine sandy loam	SM, ML	A-4	0	100	100	70-85	40-55	<30	NP-5
	12-22	Fine sandy loam, loamy fine sand.	SM	A-2, A-4	0	100	100	60-85	30-45	<30	NP-5
	22-60	Clay loam, loam	CL, CL-ML	A-4, A-6, A-7	0-5	95-100	95-100	85-95	60-80	25-45	5-25
Williams---------	0-8	Loam-------------	CL, ML	A-4, A-6, A-7	0-5	95-100	95-100	85-95	60-90	25-45	3-20
	8-23	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	23-60	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-100	60-80	30-50	10-30
33, 33B----------- Grail	0-11	Silt loam--------	CL	A-6, A-7	0	100	100	90-100	70-90	25-45	10-25
	11-20	Silty clay, silty clay loam, clay.	CL, CH, ML	A-7, A-6	0	100	100	95-100	70-95	35-55	10-35
	20-60	Loam, silty clay loam, clay.	CL, CH	A-6, A-7	0	100	100	85-100	60-95	30-55	10-30
35, 35B----------- Lawther	0-10	Silty clay-------	CL, CH	A-7	0	100	100	90-100	75-95	45-70	25-40
	10-60	Silty clay, clay, silty clay loam.	CL, CH	A-7	0	100	100	90-100	75-95	40-70	25-40
37---------------- Trembles Variant	0-12	Fine sandy loam	SM, ML	A-4, A-2	0	100	100	60-85	30-55	20-30	NP-10
	12-60	Fine sandy loam, sandy loam.	SM, ML	A-4, A-2	0	100	100	60-85	30-55	20-30	NP-10
39, 40------------ Havrelon	0-4	Silt loam--------	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	85-100	60-95	20-45	3-28
	4-60	Stratified silt loam to fine sandy loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	85-100	60-80	20-45	3-28
41---------------- Heil	0-3	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	70-95	25-50	10-25
	3-18	Silty clay, clay, silty clay loam.	CH	A-7	0	100	100	90-100	75-95	50-70	25-45
	18-60	Silty clay, clay loam, loam.	CH, CL	A-7, A-6	0	100	100	85-100	60-95	25-60	11-45
42B, 42C---------- Lefor	0-19	Fine sandy loam, sandy loam.	SM, ML, CL-ML, SM-SC	A-4	0	100	100	70-100	40-55	15-25	NP-5
	19-28	Sandy clay loam, loam.	SC, CL	A-6, A-4	0	100	100	80-100	35-55	20-40	5-25
	28-60	Weathered bedrock	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
43B-------------- Havrelon	0-4	Silt loam--------	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	85-100	60-95	20-45	3-28
	4-60	Stratified silt loam to fine sandy loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	85-100	60-80	20-45	3-28
44B, 44D--------- Lihen	0-18	Loamy fine sand	SM	A-2, A-1	0	100	85-100	45-75	15-30	---	NP
	18-32	Loamy fine sand, loamy sand, fine sand.	SM	A-2, A-1	0	100	85-100	45-75	15-35	---	NP
	32-60	Loamy fine sand, loamy sand, fine sand.	SM	A-2, A-1	0	100	85-100	45-75	15-35	---	NP
45B, 45C--------- Ruso	0-21	Sandy loam-------	SM	A-2, A-4	0-1	95-100	95-100	60-70	30-40	---	NP
	21-26	Coarse sandy loam, sandy loam.	SM	A-2, A-4	0-1	85-100	85-100	60-70	30-40	---	NP
	26-60	Stratified gravelly sand to very gravelly coarse sand.	SP-SM, SM, GM, GP-GM	A-1	0-3	50-100	50-95	10-30	5-15	---	NP
46, 46B---------- Bowdle	0-10	Loam-------------	ML, CL	A-6, A-4	0	100	95-100	85-95	55-80	30-40	7-15
	10-29	Loam, clay loam	CL, CL	A-4, A-6	0	95-100	95-100	80-95	55-75	30-40	8-15
	29-60	Sand and gravel	SM, SW-SM, SP-SM	A-1, A-2	0-5	60-95	50-85	25-50	5-30	<30	NP-5
47, 47B, 47C----- Moreau	0-7	Silty clay-------	CH	A-7	0	100	100	90-100	75-95	50-75	25-50
	7-25	Clay, silty clay, silty clay loam.	CH	A-7	0	100	100	90-100	75-95	50-75	25-50
	25-32	Clay, silty clay, silty clay loam.	CH	A-7	0	100	100	90-100	75-95	50-75	25-50
	32-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
48B-------------- Temvik	0-6	Silt loam--------	ML	A-4	0	100	100	90-100	70-90	25-40	2-10
	6-34	Silt loam, silty clay loam, clay loam.	CL	A-6	0	100	100	90-100	70-90	25-40	10-19
	34-60	Clay loam, loam	CL	A-6	0-5	95-100	95-100	80-100	55-80	25-40	10-19
49, 49B, 49C----- Morton	0-5	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	100	85-100	60-90	20-40	3-23
	5-27	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	95-100	85-95	25-50	10-30
	27-37	Loam, silt loam	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	95-100	75-95	20-50	3-30
	37-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
51C-------------- Amor	0-7	Extremely stony loam.	CL, CL-ML	A-4, A-6	3-25	100	100	90-100	65-85	20-40	5-20
	7-34	Clay loam, loam, very fine sandy loam.	CL, CL-ML	A-4, A-6, A-7	0-20	100	100	75-100	50-80	20-45	5-30
	34-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
52B*, 52C*: Morton----------	0-5	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	100	85-100	60-90	20-40	3-23
	5-27	Silty clay loam, silt loam.	CL	A-6, A-7	0	100	100	95-100	85-95	25-50	10-30
	27-37	Loam, silt loam	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	95-100	75-95	20-50	3-30
	37-60	Weathered bedrock	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification Unified	Classification AASHTO	Frag- ments > 3 inches	Percentage passing sieve number-- 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
52B*, 52C*:											
Rhoades	0-3	Silt loam	CL	A-6, A-7	0	100	100	90-100	70-85	30-45	10-25
	3-10	Clay loam, silty clay loam, clay.	CL, CH	A-7	0	100	100	90-100	80-95	40-75	20-45
	10-59	Silty clay, clay, loam.	CL, CH	A-6, A-7	0	100	100	85-100	75-95	35-70	20-40
	59-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
53B Watrous	0-7	Loam	CL, CL-ML	A-4, A-6	0	100	100	85-95	60-80	20-40	5-20
	7-27	Loam, clay loam	CL	A-6, A-7	0-5	90-100	85-100	80-100	60-80	25-45	10-30
	27-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
54B Parshall	0-15	Fine sandy loam	SM, ML	A-4, A-2	0	100	100	60-85	30-55	---	NP
	15-60	Fine sandy loam, sandy loam, loamy sand.	SM, ML	A-4, A-2	0	100	100	60-100	30-55	---	NP
55*. Pits											
58, 58B, 58C Regent	0-8	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	80-95	30-50	15-30
	8-33	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	90-100	80-95	40-70	15-45
	33-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
61B*, 61C*:											
Regent	0-8	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	80-95	30-50	15-30
	8-33	Silty clay loam, silty clay.	CL, CH	A-7	0	100	100	90-100	80-95	40-70	15-45
	33-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Rhoades	0-3	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	70-85	30-45	10-25
	3-10	Clay loam, silty clay loam, clay.	CL, CH	A-7	0	100	100	90-100	80-95	40-75	20-45
	10-59	Silty clay, clay, loam.	CL, CH	A-6, A-7	0	100	100	85-100	75-95	35-70	20-40
	59-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
62B Rhoades	0-3	Silt loam	CL	A-6, A-7	0	100	100	90-100	70-85	30-45	10-25
	3-10	Clay loam, silty clay loam, clay.	CL, CH	A-7	0	100	100	90-100	80-95	40-75	20-45
	10-59	Silty clay, clay, loam.	CL, CH	A-6, A-7	0	100	100	85-100	75-95	35-70	20-40
	59-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
62D*:											
Rhoades	0-3	Loam	SM, ML, SC, CL	A-4, A-6	0	100	100	75-90	45-65	20-35	NP-15
	3-10	Clay loam, silty clay loam, clay.	CL, CH	A-7	0	100	100	90-100	80-95	40-75	20-45
	10-59	Silty clay, clay, loam.	CL, CH	A-6, A-7	0	100	100	85-100	75-95	35-70	20-40
	59-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Cabba	0-3	Loam	ML, CL-ML	A-4	0-5	90-100	85-100	70-90	60-80	20-30	NP-10
	3-18	Gravelly loam, clay loam, silt loam.	GC, CL, SC, CL-ML	A-6, A-4	0-5	70-100	55-100	45-85	40-80	25-35	5-15
	18-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
64*. Badland											
67, 67B Savage	0-5	Silty clay loam	CL, CL-ML	A-6, A-4	0	100	100	95-100	85-95	25-40	5-15
	5-13	Clay, silty clay, silty clay loam.	CL	A-7, A-6	0	100	100	90-100	80-95	35-50	15-30
	13-60	Silty clay, silty clay loam, clay.	CL	A-7, A-6	0	100	95-100	85-100	80-95	30-50	10-30

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag- ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas- ticity index
	In				Pct					Pct	
68--------------- Vanda	0-2	Silty clay--------	CL, CH	A-7	0	100	100	90-100	75-95	40-65	20-45
	2-60	Clay, silty clay, silty clay loam.	CL, CH	A-7, A-6	0	100	100	90-100	80-95	35-65	15-45
69B*:											
Savage-----------	0-5	Silty clay loam	CL, CL-ML	A-6, A-4	0	100	100	95-100	85-95	25-40	5-15
	5-13	Clay, silty clay, silty clay loam.	CL	A-7, A-6	0	100	100	90-100	80-95	35-50	15-30
	13-60	Silty clay, silty clay loam, clay.	CL	A-7, A-6	0	100	95-100	85-100	80-95	30-50	10-30
Rhoades----------	0-3	Silty clay loam	CL	A-6, A-7	0	100	100	90-100	70-85	30-45	10-25
	3-10	Clay loam, silty clay loam, clay.	CL, CH	A-7	0	100	100	90-100	80-95	40-75	20-45
	10-59	Silty clay, clay, loam.	CL, CH	A-6, A-7	0	100	100	85-100	75-95	35-70	20-40
	59-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
70C--------------- Searing	0-8	Loam--------------	CL-ML, CL	A-4, A-6	0	100	100	85-95	65-85	20-35	5-20
	8-23	Loam, clay loam, silt loam.	CL	A-6, A-7	0	100	100	85-100	65-85	30-45	10-25
	23-33	Loam, channery loam.	ML, SM, CL, SC	A-2, A-4, A-6	0-5	60-100	40-80	35-75	30-65	20-35	3-15
	33-60	Fragmental material.	GP	A-1	80-85	15-25	5-10	0-5	0	---	NP
71B, 71C---------- Sen	0-7	Silt loam---------	CL	A-6	0	100	100	85-100	60-90	25-35	10-20
	7-34	Silt loam, silty clay loam, loam.	CL	A-6, A-7	0	100	100	85-100	60-95	25-45	10-30
	34-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
73C*:											
Cherry-----------	0-4	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	85-95	35-45	15-25
	4-26	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	70-95	25-45	10-30
	26-60	Silty clay, silty clay loam, silt loam.	CL, CH	A-6, A-7	0	100	100	90-100	70-95	25-55	10-30
Vanda------------	0-2	Silty clay--------	CL, CH	A-7	0	100	100	90-100	75-95	40-65	20-45
	2-60	Clay, silty clay, silty clay loam.	CL, CH	A-7, A-6	0	100	100	90-100	80-95	35-65	15-45
75--------------- Straw	0-23	Loam, silt loam	CL-ML	A-4	0	100	100	85-100	60-90	20-30	5-10
	23-60	Loam, silt loam, clay loam.	ML, CL	A-4, A-6	0	100	100	85-100	65-85	30-40	5-15
79--------------- Velva	0-11	Fine sandy loam	ML, SM, CL-ML, SM-SC	A-4	0	100	100	60-95	35-65	15-25	NP-5
	11-60	Fine sandy loam, loamy fine sand, loamy sand.	ML, SM	A-4	0	100	100	70-95	40-75	20-30	NP-5
81B*, 81C*:											
Vebar------------	0-23	Fine sandy loam	SM, ML	A-4, A-2	0	100	100	60-85	30-55	---	NP
	23-38	Very fine sandy loam, loamy fine sand, sandy loam	SM, ML	A-4, A-2	0	100	100	60-85	30-55	---	NP
	38-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Parshall---------	0-15	Fine sandy loam	SM, ML	A-4, A-2	0	100	100	60-85	30-55	---	NP
	15-60	Fine sandy loam, sandy loam, loamy sand.	SM, ML	A-4, A-2	0	100	100	60-100	30-55	---	NP

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
81D--------------- Vebar	0-23	Fine sandy loam	SM, ML	A-4, A-2	0	100	100	60-85	30-55	---	NP
	23-38	Very fine sandy loam, loamy fine sand, sandy loam	SM, ML	A-4, A-2	0	100	100	60-85	30-55	---	NP
	38-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
82D--------------- Vebar	0-8	Extremely stony fine sandy loam.	SM, ML	A-4, A-2	3-25	100	100	60-85	30-55	---	NP
	8-38	Very fine sandy loam, sandy loam	SM, ML	A-4, A-2	0	100	100	60-85	30-55	---	NP
	38-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
83E--------------- Baahish	0-3	Fine sandy loam	CL, CL-ML	A-4, A-6	0-5	95-100	95-100	85-95	60-80	25-40	5-15
	3-13	Loam, fine sandy loam, sandy loam.	CL, CL-ML, SM-SC, SC	A-4, A-6, A-2	0-5	80-100	75-100	65-100	30-75	25-35	5-15
	13-60	Very gravelly sandy loam, very gravelly loam, very gravelly fine sandy loam.	GM, GM-GC, SM, SM-SC	A-1	10-40	40-65	25-55	15-45	10-30	<25	NP-5
84, 84B----------- Hidatsa	0-6	Loam--------------	CL, CL-ML	A-4, A-6	0-5	100	100	85-95	60-75	25-40	5-20
	6-22	Loam, fine sandy loam.	CL, CL-ML, SC, SM-SC	A-6, A-4	0-5	95-100	95-100	70-95	40-75	25-40	5-20
	22-60	Very gravelly sandy loam, very gravelly loam.	GM, GM-GC, SM, SM-SC	A-1	15-40	40-65	25-50	15-40	10-20	<25	NP-5
86F*: Brandenburg------	0-10	Loam, very channery loam.	CL-ML, GM-GC, CL, SM-SC	A-2, A-4, A-6	0-5	60-100	40-80	35-75	30-65	20-35	5-15
	10-60	Fragmental material.	GP	A-1	80-85	15-25	5-10	0-5	0	---	NP
Cabba------------	0-3	Loam--------------	ML, CL-ML	A-4	0-5	90-100	85-100	70-90	60-80	20-30	NP-10
	3-18	Gravelly loam, clay loam, silt loam.	GC, CL, SC, CL-ML	A-6, A-4	0-5	70-100	55-100	45-85	40-80	25-35	5-15
	18-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
87F--------------- Lakoa	0-8	Loam--------------	CL, CL-ML	A-4, A-6	0	100	100	85-95	60-75	25-35	5-15
	8-29	Clay loam, sandy clay loam.	CL	A-6, A-7	0-5	95-100	90-100	85-100	50-80	35-45	12-20
	29-60	Loam, clay loam, sandy loam.	CL, SC	A-6, A-4	0-15	90-100	85-100	75-95	45-90	30-40	8-15
88, 88B, 88C------ Williams	0-8	Loam--------------	CL, ML	A-4, A-6, A-7	0-5	95-100	95-100	85-95	60-90	25-45	3-20
	8-23	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	23-60	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-100	60-80	30-50	10-30
90C--------------- Williams	0-8	Stony loam--------	CL, CL-ML	A-4, A-6, A-7	3-25	95-100	95-100	85-95	60-90	25-45	5-25
	8-23	Loam, clay loam	CL	A-6, A-7	0-20	95-100	95-100	80-95	60-80	30-50	10-30
	23-60	Loam, clay loam	CL	A-6, A-7	0-15	95-100	95-100	80-95	60-80	30-50	10-30
91B*, 91C*: Williams----------	0-8	Loam--------------	CL, ML	A-4, A-6, A-7	0-5	95-100	95-100	85-95	60-90	25-45	3-20
	8-23	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	23-60	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-100	60-80	30-50	10-30
Noonan-----------	0-8	Loam--------------	CL, CL-ML	A-4, A-6	0-1	95-100	95-100	80-95	55-75	20-40	5-25
	8-21	Clay loam---------	CL, CH	A-6, A-7	0-1	95-100	95-100	85-95	65-80	25-60	10-35
	21-60	Loam, clay loam	CL, CL-ML	A-4, A-6, A-7	0-1	95-100	95-100	80-95	60-80	25-50	5-25

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
93C*:											
Williams	0-8	Loam	CL, ML	A-4, A-6, A-7	0-5	95-100	95-100	85-95	60-90	25-45	3-20
	8-23	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	23-60	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-100	60-80	30-50	10-30
Zahl	0-5	Loam	CL	A-6	0-1	95-100	95-100	80-95	55-75	25-40	10-20
	5-60	Clay loam, loam	CL	A-6	0-1	95-100	90-100	80-95	60-80	25-40	10-20
93D*, 93E*:											
Zahl	0-5	Loam	CL	A-6	0-1	95-100	95-100	80-95	55-75	25-40	10-20
	5-60	Clay loam, loam	CL	A-6	0-1	95-100	90-100	80-95	60-80	25-40	10-20
Williams	0-8	Loam	CL, ML	A-4, A-6, A-7	0-5	95-100	95-100	85-95	60-90	25-45	3-20
	8-23	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-100	60-80	30-50	10-30
	23-60	Clay loam, loam	CL	A-6, A-7	0-5	95-100	95-100	80-100	60-80	30-50	10-30
94B Moreau Variant	0-6	Clay loam	CL	A-6, A-7	0	100	100	90-100	80-95	30-50	15-30
	6-17	Silty clay, silty clay loam, clay loam.	CH, CL	A-7	0	100	100	90-100	80-95	40-70	15-45
	17-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
94E Wayden	0-4	Silty clay	CH, CL	A-7	0	100	100	90-100	75-95	40-60	15-30
	4-16	Silty clay, clay, silty clay loam.	CH, CL	A-7	0	100	100	90-100	75-95	40-60	15-30
	16-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
101B, 101C Amor	0-7	Loam	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	65-85	25-40	3-18
	7-34	Clay loam, loam, very fine sandy loam.	ML, CL, CL-ML	A-4, A-6, A-7	0	100	100	75-100	50-80	20-45	2-25
	34-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
102, 102B Shambo	0-4	Loam	ML, CL, CL-ML	A-4, A-6	0	100	100	85-95	60-75	25-35	3-13
	4-60	Loam, silt loam, clay loam.	ML, CL, CL-ML	A-4, A-6	0	100	100	85-95	60-75	25-40	3-18
105 Harriet	0-2	Silt loam	CL, CL-ML	A-4, A-6	0	100	100	85-100	60-90	25-40	5-20
	2-10	Clay loam, silty clay loam, silty clay.	CL, CH	A-7, A-6	0	100	100	90-100	70-95	35-70	20-40
	10-60	Sandy clay loam, loam, silty clay loam, silty clay	CL, CL-ML, CH	A-4, A-6, A-7	0	100	100	90-100	60-95	20-65	5-40
106B Daglum	0-7	Silt loam	CL	A-6, A-7	0	100	100	90-100	70-85	30-45	15-25
	7-18	Clay, silty clay, silty clay loam.	CL, CH	A-7, A-6	0	100	100	90-100	70-95	35-75	15-45
	18-46	Clay loam, silty clay, silty clay loam.	CL	A-7	0	100	100	90-100	65-95	40-50	20-30
	46-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
107*. Aquents											
109B Ekalaka	0-11	Fine sandy loam	SM, ML	A-2, A-4	0	100	100	70-85	30-60	20-35	NP-10
	11-21	Fine sandy loam, sandy loam, loamy fine sand.	SM, ML	A-2, A-4	0	100	100	70-90	30-70	20-35	NP-10
	21-60	Fine sandy loam, loamy fine sand, fine sand.	SM	A-2, A-4	0	100	100	50-75	30-40	20-35	NP-10

See footnote at end of table.

TABLE 14.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
207F------------- Arikara	0-6	Loam-------------	CL, CL-ML	A-4, A-6, A-7	0	100	100	90-100	70-85	25-45	5-25
	6-60	Loam, clay loam, fine sandy loam.	CL, CL-ML, SC, SM-SC	A-4, A-6, A-7	0	100	100	70-100	40-85	20-45	5-25
209E*: Cherry----------	0-4	Silty clay loam	CL	A-6, A-7	0	100	100	95-100	85-95	35-45	15-25
	4-26	Silt loam, silty clay loam.	CL	A-6, A-7	0	100	100	90-100	70-95	25-45	10-30
	26-60	Silty clay, silty clay loam, silt loam.	CL, CH	A-6, A-7	0	100	100	90-100	70-95	25-55	10-30
Cabba-----------	0-3	Loam-------------	ML, CL-ML	A-4	0-5	90-100	85-100	70-90	60-80	20-30	NP-10
	3-18	Gravelly loam, clay loam, silt loam.	GC, CL, SC, CL-ML	A-6, A-4	0-5	70-100	55-100	45-85	40-80	25-35	5-15
	18-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
211F*: Badland.											
Cabba-----------	0-3	Loam-------------	ML, CL-ML	A-4	0-5	90-100	85-100	70-90	60-80	20-30	NP-10
	3-18	Gravelly loam, clay loam, silt loam.	GC, CL, SC, CL-ML	A-6, A-4	0-5	70-100	55-100	45-85	40-80	25-35	5-15
	18-60	Weathered bedrock	---	---	---	---	---	---	---	---	---
Arikara---------	0-6	Loam-------------	CL, CL-ML	A-4, A-6, A-7	0	100	100	90-100	70-85	25-45	5-25
	6-60	Loam, clay loam, fine sandy loam.	CL, CL-ML, SC, SM-SC	A-4, A-6, A-7	0	100	100	70-100	40-85	20-45	5-25

* See description of the map unit for composition and behavior characteristics of the map unit.
** NP means nonplastic.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "wind erodibility group" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group
							K	T	
	In	In/hr	In/in	pH	Mmhos/cm				
3----------------- Straw	0-23	0.6-2.0	0.16-0.18	6.6-8.4	<2	Low--------	0.32	5	5
	23-60	0.6-2.0	0.16-0.19	7.4-8.4	<2	Moderate	0.32		
4, 4B------------ Arnegard	0-10	0.6-2.0	0.20-0.24	6.1-7.3	<2	Moderate	0.28	5	6
	10-42	0.6-2.0	0.16-0.22	6.6-7.8	<2	Moderate	0.28		
	42-60	0.6-2.0	0.14-0.18	6.6-8.4	<2	Low--------	0.28		
5----------------- Tonka	0-13	0.6-2.0	0.18-0.23	5.6-7.3	<2	Low--------	0.32	5	6
	13-36	0.06-0.2	0.14-0.19	5.6-7.3	<2	High-------	0.43		
	36-60	0.2-0.6	0.14-0.19	6.6-9.0	<2	Moderate	0.43		
7*:									
Straw------------	0-23	0.6-2.0	0.16-0.18	6.6-8.4	<2	Low--------	0.32	5	5
	23-60	0.6-2.0	0.16-0.19	7.4-8.4	<2	Moderate	0.32		
Rhoades----------	0-3	0.6-6.0	0.15-0.17	5.6-7.3	<2	Low--------	0.32	3	6
	3-18	<0.06	0.10-0.12	>7.3	2-16	High-------	0.32		
	18-60	<0.06	0.10-0.12	>7.8	8-16	High-------	0.32		
8C*:									
Cabba------------	0-3	0.6-2.0	0.16-0.20	6.6-8.4	<4	Low--------	0.37	1	6
	3-18	0.6-2.0	0.14-0.18	7.4-8.4	2-8	Moderate	0.37		
	18-60	---	---	---	---	-----------	----		
Chama------------	0-8	0.6-2.0	0.20-0.24	6.6-7.8	<2	Moderate	0.28	4	6
	8-30	0.6-2.0	0.18-0.20	7.4-8.4	<2	Moderate	0.43		
	30-60	---	---	---	---	-----------	----		
9D*:									
Amor-------------	0-7	0.6-2.0	0.20-0.23	6.1-7.3	<2	Moderate	0.28	4	6
	7-34	0.6-2.0	0.15-0.18	6.6-8.4	<2	Moderate	0.28		
	34-60	---	---	---	---	-----------	----		
Cabba------------	0-3	0.6-2.0	0.16-0.20	6.6-8.4	<4	Low--------	0.37	1	6
	3-18	0.6-2.0	0.14-0.18	7.4-8.4	2-8	Moderate	0.37		
	18-60	---	---	---	---	-----------	----		
9E---------------- Cabba	0-3	0.6-2.0	0.16-0.20	6.6-8.4	<4	Low--------	0.37	1	6
	3-18	0.6-2.0	0.14-0.18	7.4-8.4	2-8	Moderate	0.37		
	18-60	---	---	---	---	-----------	----		
10D--------------- Cabba	0-3	0.6-2.0	0.12-0.16	6.6-8.4	<4	Low--------	0.28	1	8
	3-18	0.6-2.0	0.14-0.18	7.4-8.4	2-8	Moderate	0.32		
	18-60	---	---	---	---	-----------	----		
11F*:									
Cabba------------	0-3	0.6-2.0	0.16-0.20	6.6-8.4	<4	Low--------	0.37	1	6
	3-18	0.6-2.0	0.14-0.18	7.4-8.4	2-8	Moderate	0.37		
	18-60	---	---	---	---	-----------	----		
Badland.									
12---------------- Banks	0-4	6.0-20	0.06-0.09	6.6-7.8	<2	Low--------	0.17	5	2
	4-60	6.0-20	0.07-0.09	7.4-8.4	<2	Low--------	0.17		
13D--------------- Wabek	0-6	2.0-6.0	0.20-0.22	6.6-7.8	<2	Low--------	0.28	2	5
	6-11	2.0-6.0	0.11-0.15	6.6-7.8	<2	Low--------	0.10		
	11-60	>20	0.02-0.04	7.4-7.8	<2	Low--------	0.10		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	In/hr	In/in	pH	Mmhos/cm				
15*:									
Belfield---------	0-12	0.6-2.0	0.20-0.23	6.1-7.3	<2	Moderate	0.32	5	6
	12-30	0.06-0.2	0.14-0.18	6.6-7.8	<2	High------	0.32		
	30-60	0.06-0.2	0.13-0.16	7.9-9.0	4-16	High------	0.32		
Farland----------	0-8	0.6-2.0	0.19-0.21	6.1-7.8	<2	Low--------	0.32	5	6
	8-18	0.6-2.0	0.16-0.20	6.6-7.8	<2	Moderate	0.32		
	18-31	0.6-2.0	0.17-0.20	6.6-8.4	<4	Moderate	0.32		
	31-60	0.6-2.0	0.16-0.18	7.9-9.0	<8	Moderate	0.32		
16B*:									
Belfield---------	0-12	0.2-2.0	0.17-0.22	6.1-7.3	<2	High------	0.32	5	7
	12-30	0.06-0.2	0.14-0.18	6.6-7.8	<2	High------	0.32		
	30-60	0.06-0.2	0.13-0.16	7.9-9.0	4-16	High------	0.32		
Savage-----------	0-5	0.6-2.0	0.16-0.20	6.6-7.8	<2	Moderate	0.37	5	7
	5-13	0.06-0.2	0.14-0.18	6.6-8.4	2-8	High------	0.32		
	13-60	0.06-0.2	0.13-0.17	7.4-8.4	2-8	High------	0.32		
18*:									
Belfield---------	0-12	0.2-2.0	0.17-0.22	6.1-7.3	<2	High------	0.32	5	7
	12-30	0.06-0.2	0.14-0.18	6.6-7.8	<2	High------	0.32		
	30-60	0.06-0.2	0.13-0.16	7.9-9.0	4-16	High------	0.32		
Grail------------	0-11	0.2-0.6	0.20-0.23	6.1-7.3	<2	Moderate	0.32	5	7
	11-20	0.06-0.2	0.14-0.17	6.6-7.3	<2	High------	0.32		
	20-60	0.06-0.2	0.13-0.22	7.4-8.4	<4	Moderate	0.32		
19B*:									
Belfield---------	0-12	0.6-2.0	0.20-0.23	6.1-7.3	<2	Moderate	0.32	5	6
	12-30	0.06-0.2	0.14-0.18	6.6-7.8	<2	High------	0.32		
	30-60	0.06-0.2	0.13-0.16	7.9-9.0	4-16	High------	0.32		
Morton-----------	0-5	0.6-2.0	0.20-0.24	6.6-7.3	<2	Low--------	0.32	4	6
	5-27	0.6-2.0	0.16-0.20	6.6-7.8	<2	Moderate	0.43		
	27-37	0.6-2.0	0.16-0.20	7.4-8.4	<2	Moderate	0.43		
	37-60	---	---	---	---	-----------	----		
21B, 21C---------- Cherry	0-4	0.2-0.6	0.18-0.23	6.6-7.8	<2	Moderate	0.37	5	7
	4-26	0.06-0.6	0.16-0.22	7.9-9.0	<2	Moderate	0.37		
	26-60	0.06-0.6	0.13-0.22	7.9-9.0	<8	Moderate	0.37		
22---------------- Colvin	0-14	0.6-2.0	0.15-0.17	7.4-9.0	4-16	Moderate	0.32	5	4L
	14-60	0.06-2.0	0.11-0.15	7.4-9.0	4-16	Moderate	0.32		
24---------------- Dimmick	0-20	<0.2	0.14-0.23	6.1-7.3	<2	High------	0.28	5	4
	20-60	<0.06	0.13-0.20	6.6-7.8	<2	High------	0.28		
25F*:									
Baahish----------	0-3	0.6-2.0	0.18-0.20	6.1-7.3	<2	Moderate	0.28	2	3
	3-13	0.6-2.0	0.18-0.20	6.6-7.8	<2	Moderate	0.28		
	13-60	6.0-20	0.03-0.05	7.4-8.4	<2	Low--------	0.10		
Rock outcrop.									
27, 27B----------- Farland	0-8	0.6-2.0	0.19-0.21	6.1-7.8	<2	Low--------	0.32	5	6
	8-18	0.6-2.0	0.16-0.20	6.6-7.8	<2	Moderate	0.32		
	18-31	0.6-2.0	0.17-0.20	6.6-8.4	<4	Moderate	0.32		
	31-60	0.6-2.0	0.16-0.18	7.9-9.0	<8	Moderate	0.32		
29B*:									
Farland----------	0-8	0.6-2.0	0.19-0.21	6.1-7.8	<2	Low--------	0.32	5	6
	8-18	0.6-2.0	0.16-0.20	6.6-7.8	<2	Moderate	0.32		
	18-31	0.6-2.0	0.17-0.20	6.6-8.4	<4	Moderate	0.32		
	31-60	0.6-2.0	0.16-0.18	7.9-9.0	<8	Moderate	0.32		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	In/hr	In/in	pH	Mmhos/cm				
29B*:									
Rhoades----------	0-3	0.6-2.0	0.15-0.17	5.6-7.3	<2	Moderate	0.32	3	6
	3-10	<0.2	0.10-0.12	>7.3	2-16	High------	0.32		
	10-59	<0.2	0.10-0.12	>7.8	8-16	High------	0.32		
	59-60	---	---	---	---	----------	----		
30E*:									
Cohagen----------	0-15	2.0-6.0	0.13-0.18	7.4-8.4	<2	Low-------	0.24	2	3
	15-60	---	---	---	---	----------	----		
Vebar------------	0-23	2.0-6.0	0.15-0.17	6.1-7.8	<2	Low-------	0.20	4	3
	23-38	2.0-6.0	0.15-0.17	6.1-8.4	<2	Low-------	0.20		
	38-60	---	---	---	---	----------	----		
31F*:									
Cohagen----------	0-15	2.0-6.0	0.13-0.18	7.4-8.4	<2	Low-------	0.24	2	3
	15-60	---	---	---	---	----------	----		
Vebar------------	0-23	2.0-6.0	0.15-0.17	6.1-7.8	<2	Low-------	0.20	4	3
	23-38	2.0-6.0	0.15-0.17	6.1-8.4	<2	Low-------	0.20		
	38-60	---	---	---	---	----------	----		
Rock outcrop.									
32B*, 32C*:									
Flaxton----------	0-12	2.0-6.0	0.16-0.18	6.6-7.3	<2	Low-------	0.20	5	3
	12-22	2.0-6.0	0.15-0.17	6.6-7.3	<2	Low-------	0.20		
	22-60	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	0.37		
Williams---------	0-8	0.6-2.0	0.17-0.24	6.6-7.3	<2	Low-------	0.28	5	6
	8-23	0.6-2.0	0.16-0.20	6.6-7.8	<2	Moderate	0.28		
	23-60	0.06-0.6	0.15-0.18	7.9-8.4	<2	Moderate	0.37		
33, 33B---------- Grail	0-11	0.2-0.6	0.22-0.24	6.1-7.3	<2	Moderate	0.32	5	6
	11-20	0.06-0.2	0.14-0.17	6.6-7.3	<2	High------	0.32		
	20-60	0.06-0.2	0.13-0.22	7.4-8.4	<4	Moderate	0.32		
35, 35B---------- Lawther	0-10	0.06-0.2	0.14-0.17	7.4-8.4	<8	High------	0.32	5	4
	10-60	0.06-0.2	0.14-0.17	7.4-9.0	<8	High------	0.32		
37--------------- Trembles Variant	0-12	2.0-6.0	0.16-0.18	7.9-8.4	<2	Low-------	0.20	5	3
	12-60	2.0-6.0	0.11-0.17	7.9-8.4	<2	Low-------	0.20		
39, 40----------- Havrelon	0-4	0.6-2.0	0.20-0.24	7.4-7.8	<2	Moderate	0.32	5	4L
	4-60	0.6-2.0	0.15-0.19	7.4-7.8	<2	Moderate	0.32		
41--------------- Heil	0-3	<0.06	0.15-0.24	5.6-7.3	<2	Moderate	0.28	3	7
	3-18	<0.06	0.13-0.18	6.6-9.0	4-16	High------	0.28		
	18-60	<0.06	0.13-0.18	7.9-9.0	4-16	High------	0.28		
42B, 42C--------- Lefor	0-19	2.0-6.0	0.16-0.18	5.1-7.3	<2	Low-------	0.20	4	3
	19-28	0.6-2.0	0.15-0.17	6.6-7.8	<2	Moderate	0.32		
	28-60	---	---	---	---	----------	----		
43B-------------- Havrelon	0-4	0.6-2.0	0.20-0.24	7.4-7.8	<2	Moderate	0.32	5	4L
	4-60	0.6-2.0	0.15-0.19	7.4-7.8	<2	Moderate	0.32		
44B, 44D--------- Lihen	0-18	6.0-20	0.08-0.12	6.6-7.8	<2	Low-------	0.17	5	2
	18-32	6.0-20	0.07-0.11	6.6-7.8	<2	Low-------	0.17		
	32-60	6.0-20	0.08-0.12	7.4-8.4	<2	Low-------	0.17		
45B, 45C--------- Ruso	0-21	2.0-6.0	0.13-0.15	6.6-7.3	<2	Low-------	0.20	4	3
	21-26	2.0-6.0	0.11-0.15	6.6-8.4	<2	Low-------	0.20		
	26-60	>20.0	0.02-0.04	7.4-8.4	<2	Low-------	0.10		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	In/hr	In/in	pH	Mmhos/cm				
46, 46B----------Bowdle	0-10	0.6-2.0	0.18-0.20	6.1-7.3	<2	Low--------	0.28	4	6
	10-29	0.6-2.0	0.18-0.20	6.1-7.3	<2	Low--------	0.28		
	29-60	6.0-20	0.03-0.06	7.4-8.4	<2	Low--------	0.10		
47, 47B, 47C-----Moreau	0-7	0.06-0.2	0.15-0.18	7.4-8.4	<2	High-------	0.32	4	4L
	7-25	0.06-0.2	0.14-0.17	7.9-9.0	<4	High-------	0.32		
	25-32	0.06-0.2	0.13-0.15	7.9-9.0	2-16	High-------	0.32		
	32-60	---	---	---	---	-----------	----		
48B--------------Temvik	0-6	0.6-2.0	0.22-0.24	6.6-7.3	<2	Low--------	0.32	5	6
	6-34	0.6-2.0	0.20-0.22	6.6-8.4	<2	Low--------	0.43		
	34-60	0.2-0.6	0.15-0.19	7.4-8.4	<2	Moderate	0.43		
49, 49B, 49C-----Morton	0-5	0.6-2.0	0.20-0.24	6.6-7.3	<2	Low--------	0.32	4	6
	5-27	0.6-2.0	0.16-0.20	6.6-7.8	<2	Moderate	0.43		
	27-37	0.6-2.0	0.16-0.20	7.4-8.4	<2	Moderate	0.43		
	37-60	---	---	---	---	-----------	----		
51C--------------Amor	0-7	0.6-2.0	0.20-0.23	6.1-7.3	<2	Moderate	0.20	4	8
	7-34	0.6-2.0	0.15-0.18	6.6-8.4	<2	Moderate	0.28		
	34-60	---	---	---	---	-----------	----		
52B*, 52C*:									
Morton-----------	0-5	0.6-2.0	0.20-0.24	6.6-7.3	<2	Low--------	0.32	4	6
	5-27	0.6-2.0	0.16-0.20	6.6-7.8	<2	Moderate	0.43		
	27-37	0.6-2.0	0.16-0.20	7.4-8.4	<2	Moderate	0.43		
	37-60	---	---	---	---	-----------	----		
Rhoades----------	0-3	0.6-2.0	0.15-0.17	5.6-7.3	<2	Moderate	0.32	3	6
	3-10	<0.2	0.10-0.12	>7.3	2-16	High-------	0.32		
	10-59	<0.2	0.10-0.12	>7.8	8-16	High-------	0.32		
	59-60	---	---	---	---	-----------	----		
53B--------------Watrous	0-7	0.6-2.0	0.20-0.24	6.6-7.8	<2	Moderate	0.28	4	5
	7-27	0.6-2.0	0.15-0.19	6.6-7.8	<2	Moderate	0.28		
	27-60	---	---	---	---	-----------	----		
54B--------------Parshall	0-15	2.0-6.0	0.16-0.18	6.6-8.4	<2	Low--------	0.20	5	3
	15-60	2.0-6.0	0.12-0.17	6.6-8.4	<2	Low--------	0.20		
55*. Pits									
58, 58B, 58C-----Regent	0-8	0.06-0.2	0.17-0.20	6.1-7.3	<2	High-------	0.32	4	7
	8-33	0.06-0.2	0.17-0.20	7.4-9.0	<8	High-------	0.32		
	33-60	---	---	---	---	-----------	----		
61B*, 61C*:									
Regent-----------	0-8	0.06-0.2	0.17-0.20	6.1-7.3	<2	High-------	0.32	4	7
	8-33	0.06-0.2	0.17-0.20	7.4-9.0	<8	High-------	0.32		
	33-60	---	---	---	---	-----------	----		
Rhoades----------	0-3	0.6-2.0	0.15-0.17	5.6-7.3	<2	Moderate	0.32	3	6
	3-10	<0.2	0.10-0.12	>7.3	2-16	High-------	0.32		
	10-59	<0.2	0.10-0.12	>7.8	8-16	High-------	0.32		
	59-60	---	---	---	---	-----------	----		
62B--------------Rhoades	0-3	0.6-2.0	0.15-0.17	5.6-7.3	<2	Moderate	0.32	3	6
	3-10	<0.2	0.10-0.12	>7.3	2-16	High-------	0.32		
	10-59	<0.2	0.10-0.12	>7.8	8-16	High-------	0.32		
	59-60	---	---	---	---	-----------	----		
62D*:									
Rhoades----------	0-3	0.6-6.0	0.13-0.15	5.6-7.3	<2	Low--------	0.32	3	6
	3-10	<0.2	0.10-0.12	>7.3	2-16	High-------	0.32		
	10-59	<0.2	0.10-0.12	>7.8	8-16	High-------	0.32		
	59-60	---	---	---	---	-----------	----		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	In/hr	In/in	pH	Mmhos/cm				
62D*:									
Cabba	0-3	0.6-2.0	0.16-0.20	6.6-8.4	<4	Low	0.37	1	6
	3-18	0.6-2.0	0.14-0.18	7.4-8.4	2-8	Moderate	0.37		
	18-60	---	---	---	---	----------	----		
64*. Badland									
67, 67B Savage	0-5	0.6-2.0	0.16-0.20	6.6-7.8	<2	Moderate	0.37	5	7
	5-13	0.06-0.2	0.14-0.18	6.6-8.4	2-8	High	0.32		
	13-60	0.06-0.2	0.13-0.17	7.4-8.4	2-8	High	0.32		
68 Vanda	0-2	<0.06	0.08-0.12	7.9-9.0	8-16	High	0.37	5	4
	2-60	<0.06	0.08-0.12	>7.8	8-16	High	0.37		
69B*:									
Savage	0-5	0.6-2.0	0.16-0.20	6.6-7.8	<2	Moderate	0.37	5	7
	5-13	0.06-0.2	0.14-0.18	6.6-8.4	2-8	High	0.32		
	13-60	0.06-0.2	0.13-0.17	7.4-8.4	2-8	High	0.32		
Rhoades	0-3	0.6-2.0	0.15-0.17	5.6-7.3	<2	Moderate	0.32	3	6
	3-10	<0.2	0.10-0.12	>7.3	2-16	High	0.32		
	10-59	<0.2	0.10-0.12	>7.8	8-16	High	0.32		
	59-60	---	---	---	---	----------	----		
70C Searing	0-8	0.6-2.0	0.20-0.23	6.1-7.3	<2	Low	0.28	4	6
	8-23	0.6-2.0	0.17-0.20	6.6-8.4	<2	Moderate	0.28		
	23-33	0.6-6.0	0.16-0.18	7.4-8.4	<2	Low	0.28		
	33-60	>20	0.01-0.03	7.4-8.4	<2	Low	0.10		
71B, 71C Sen	0-7	0.6-2.0	0.20-0.24	6.6-7.8	<2	Moderate	0.32	4	6
	7-34	0.6-2.0	0.16-0.22	6.6-9.0	<2	Moderate	0.43		
	34-60	---	---	---	---	----------	----		
73C*:									
Cherry	0-4	0.2-0.6	0.18-0.23	6.6-7.8	<2	Moderate	0.37	5	7
	4-26	0.06-0.6	0.16-0.22	7.9-9.0	<2	Moderate	0.37		
	26-60	0.06-0.6	0.13-0.22	7.9-9.0	<8	Moderate	0.37		
Vanda	0-2	<0.06	0.08-0.12	7.9-9.0	8-16	High	0.37	5	4
	2-60	<0.06	0.08-0.12	>7.8	8-16	High	0.37		
75 Straw	0-23	0.6-2.0	0.16-0.18	6.6-8.4	<2	Low	0.32	5	5
	23-60	0.6-2.0	0.16-0.19	7.4-8.4	<2	Moderate	0.32		
79 Velva	0-11	0.6-6.0	0.13-0.22	6.6-7.3	<2	Low	0.20	5	3
	11-60	0.6-6.0	0.16-0.22	6.6-8.4	<2	Low	0.20		
81B*, 81C*:									
Vebar	0-23	2.0-6.0	0.15-0.17	6.1-7.8	<2	Low	0.20	4	3
	23-38	2.0-6.0	0.15-0.17	6.1-8.4	<2	Low	0.20		
	38-60	---	---	---	---	----------	----		
Parshall	0-15	2.0-6.0	0.16-0.18	6.6-8.4	<2	Low	0.20	5	3
	15-60	2.0-6.0	0.12-0.17	6.6-8.4	<2	Low	0.20		
81D Vebar	0-23	2.0-6.0	0.15-0.17	6.1-7.8	<2	Low	0.20	4	3
	23-38	2.0-6.0	0.15-0.17	6.1-8.4	<2	Low	0.20		
	38-60	---	---	---	---	----------	----		
82D Vebar	0-8	2.0-6.0	0.15-0.17	6.1-7.8	<2	Low	0.20	4	8
	8-38	2.0-6.0	0.15-0.17	6.1-8.4	<2	Low	0.20		
	38-60	---	---	---	---	----------	----		
83E Baahish	0-3	0.6-2.0	0.18-0.20	6.1-7.3	<2	Moderate	0.28	2	3
	3-13	0.6-2.0	0.18-0.20	6.6-7.8	<2	Moderate	0.28		
	13-60	6.0-20	0.03-0.05	7.4-8.4	<2	Low	0.10		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group
	In	In/hr	In/in	pH	Mmhos/cm				
84, 84B----------- Hidatsa	0-6	0.6-2.0	0.18-0.20	6.1-7.3	<2	Moderate	0.28	4	6
	6-22	0.6-2.0	0.18-0.22	6.1-7.3	<2	Moderate	0.28		
	22-60	6.0-20	0.03-0.05	7.4-8.4	<2	Low--------	0.10		
86F*:									
Brandenburg------	0-10	0.6-20	0.18-0.20	6.6-7.8	<2	Low--------	0.24	2	6
	10-60	>20	0.01-0.03	6.6-8.4	<2	Low--------	0.10		
Cabba------------	0-3	0.6-2.0	0.16-0.20	6.6-8.4	<4	Low--------	0.37	1	6
	3-18	0.6-2.0	0.14-0.18	7.4-8.4	2-8	Moderate	0.37		
	18-60	---	---	---	---	-----------	----		
87F--------------- Lakoa	0-8	0.6-2.0	0.17-0.20	5.1-7.3	<2	Low--------	0.32	5	5
	8-29	0.6-2.0	0.17-0.20	5.6-7.3	<2	Moderate	0.32		
	29-60	0.6-2.0	0.16-0.20	5.6-7.8	<2	Moderate	0.32		
88, 88B, 88C------ Williams	0-8	0.6-2.0	0.17-0.24	6.6-7.3	<2	Low--------	0.28	5	6
	8-23	0.6-2.0	0.16-0.20	6.6-7.8	<2	Moderate	0.28		
	23-60	0.06-0.6	0.15-0.18	7.9-8.4	<2	Moderate	0.37		
90C--------------- Williams	0-8	0.6-2.0	0.17-0.24	6.6-7.3	<2	Low--------	0.20	5	8
	8-23	0.6-2.0	0.16-0.20	6.6-7.8	<2	Moderate	0.32		
	23-60	0.06-0.6	0.15-0.18	7.9-8.4	<2	Moderate	0.32		
91B*, 91C*:									
Williams---------	0-8	0.6-2.0	0.17-0.24	6.6-7.3	<2	Low--------	0.28	5	6
	8-23	0.6-2.0	0.16-0.20	6.6-7.8	<2	Moderate	0.28		
	23-60	0.06-0.6	0.15-0.18	7.9-8.4	<2	Moderate	0.37		
Noonan-----------	0-8	0.6-2.0	0.20-0.22	6.1-7.3	<2	Moderate	0.32	3	6
	8-21	0.06-0.2	0.12-0.14	6.6-9.0	<2	High-------	0.32		
	21-60	0.06-0.2	0.10-0.14	7.9-9.0	2-8	Moderate	0.32		
93C*:									
Williams---------	0-8	0.6-2.0	0.17-0.24	6.6-7.3	<2	Low--------	0.28	5	6
	8-23	0.6-2.0	0.16-0.20	6.6-7.8	<2	Moderate	0.28		
	23-60	0.06-0.6	0.15-0.18	7.9-8.4	<2	Moderate	0.37		
Zahl-------------	0-5	0.6-2.0	0.17-0.22	6.6-7.8	<2	Moderate	0.28	5	4L
	5-60	0.06-0.6	0.15-0.19	7.4-8.4	<2	Moderate	0.37		
93D*, 93E*:									
Zahl-------------	0-5	0.6-2.0	0.17-0.22	6.6-7.8	<2	Moderate	0.28	5	4L
	5-60	0.06-0.6	0.15-0.19	7.4-8.4	<2	Moderate	0.37		
Williams---------	0-8	0.6-2.0	0.17-0.24	6.6-7.3	<2	Low--------	0.28	5	6
	8-23	0.6-2.0	0.16-0.20	6.6-7.8	<2	Moderate	0.28		
	23-60	0.06-0.6	0.15-0.18	7.9-8.4	<2	Moderate	0.37		
94B--------------- Moreau Variant	0-6	0.06-0.2	0.17-0.19	5.6-6.0	<8	High-------	0.32	3	6
	6-17	0.06-0.2	0.14-0.20	6.1-7.3	<8	High-------	0.32		
	17-60	---	---	---	---	-----------	----		
94E--------------- Wayden	0-4	0.06-0.2	0.14-0.19	7.4-9.0	<8	High-------	0.32	2	4L
	4-16	0.06-0.2	0.14-0.19	7.4-9.0	<8	High-------	0.32		
	16-60	---	---	---	---	-----------	----		
101B, 101C-------- Amor	0-7	0.6-2.0	0.20-0.23	6.1-7.3	<2	Moderate	0.28	4	6
	7-34	0.6-2.0	0.15-0.18	6.6-8.4	<2	Moderate	0.28		
	34-60	---	---	---	---	-----------	----		
102, 102B--------- Shambo	0-4	0.6-2.0	0.20-0.22	6.6-7.3	<2	Low--------	0.28	5	6
	4-60	0.6-2.0	0.17-0.19	6.6-8.4	<2	Moderate	0.28		
105--------------- Harriet	0-2	0.06-0.2	0.20-0.24	6.6-8.4	<2	Moderate	0.37	3	6
	2-10	<0.06	0.10-0.15	>7.3	4-16	High-------	0.37		
	10-60	0.06-0.2	0.10-0.15	>7.8	4-16	Moderate	0.37		

See footnote at end of table.

TABLE 15.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors		Wind erodibility group
							K	T	
	In	In/hr	In/in	pH	Mmhos/cm				
106B-------------- Daglum	0-7	0.6-2.0	0.16-0.18	6.1-7.3	<2	Moderate	0.32	3	6
	7-18	<0.2	0.12-0.14	6.6-9.0	2-8	High------	0.32		
	18-46	<0.2	0.12-0.14	7.9-9.0	8-16	High------	0.32		
	46-60	---	---	---	---	----------	----		
107*. Aquents									
109B-------------- Ekalaka	0-11	2.0-6.0	0.13-0.20	6.1-8.4	<2	Low-------	0.24	3	3
	11-21	0.06-0.2	0.11-0.13	7.4-9.0	2-8	Low-------	0.24		
	21-60	0.06-6.0	0.06-0.08	7.9-9.0	4-16	Low-------	0.24		
207F-------------- Arikara	0-13	0.6-2.0	0.19-0.22	6.1-7.8	<2	Moderate	0.28	5	6
	13-60	0.6-2.0	0.13-0.20	7.4-9.0	<4	Moderate	0.28		
209E*: Cherry-----------	0-4	0.2-0.6	0.18-0.23	6.6-7.8	<2	Moderate	0.37	5	7
	4-26	0.06-0.6	0.16-0.22	7.9-9.0	<2	Moderate	0.37		
	26-60	0.06-0.6	0.13-0.22	7.9-9.0	<8	Moderate	0.37		
Cabba------------	0-3	0.6-2.0	0.16-0.20	6.6-8.4	<4	Low-------	0.37	1	6
	3-18	0.6-2.0	0.14-0.18	7.4-8.4	2-8	Moderate	0.37		
	18-60	---	---	---	---	----------	----		
211F*: Badland.									
Cabba------------	0-3	0.6-2.0	0.16-0.20	6.6-8.4	<4	Low-------	0.37	1	6
	3-18	0.6-2.0	0.14-0.18	7.4-8.4	2-8	Moderate	0.37		
	18-60	---	---	---	---	----------	----		
Arikara----------	0-13	0.6-2.0	0.19-0.22	6.1-7.8	<2	Moderate	0.28	5	6
	13-60	0.6-2.0	0.13-0.20	7.4-9.0	<4	Moderate	0.28		

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--SOIL AND WATER FEATURES

["Flooding" and "water table" and terms such as "rare," "brief," "apparent," and "perched" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated]

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
3---------------- Straw	B	Frequent----	Brief-----	Mar-May	>6.0	---	---	>60	---	Moderate	High-----	Moderate.
4, 4B------------ Arnegard	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Low.
5*--------------- Tonka	C/D	None--------	---	---	+.5-1.0	Apparent	Apr-Jun	>60	---	High-----	High-----	Low.
7**:												
Straw-----------	B	Occasional	Brief-----	Mar-May	>6.0	---	---	>60	---	Moderate	High-----	Moderate.
Rhoades----------	D	Occasional	Brief-----	Mar-May	>6.0	---	---	>60	---	Low------	High-----	Low.
8C**:												
Cabba-----------	C	None--------	---	---	>6.0	---	---	10-20	Soft	Moderate	High-----	Low.
Chama-----------	B	None--------	---	---	>6.0	---	---	20-40	Soft	Moderate	High-----	Low.
9D**:												
Amor------------	B	None--------	---	---	>6.0	---	---	20-40	Soft	Moderate	High-----	Moderate.
Cabba-----------	C	None--------	---	---	>6.0	---	---	10-20	Soft	Moderate	High-----	Low.
9E, 10D---------- Cabba	C	None--------	---	---	>6.0	---	---	10-20	Soft	Moderate	High-----	Low.
11F**:												
Cabba-----------	C	None--------	---	---	>6.0	---	---	10-20	Soft	Moderate	High-----	Low.
Badland.												
12--------------- Banks	A	Frequent----	Brief-----	Mar-Jun	>6.0	---	---	>60	---	Low------	Moderate	Low.
13D-------------- Wabek	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Moderate	Low.
15**:												
Belfield---------	C	None--------	---	---	>6.0	---	---	>60	---	Low------	High-----	Low.
Farland----------	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Moderate.
16B**:												
Belfield---------	C	None--------	---	---	>6.0	---	---	>60	---	Low------	High-----	Low.
Savage-----------	C	None--------	---	---	>6.0	---	---	>60	---	Low------	High-----	Moderate.
18**:												
Belfield---------	C	None--------	---	---	>6.0	---	---	>60	---	Low------	High-----	Low.

See footnotes at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hardness	Potential frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In				
18**:												
Grail------------	C	None--------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Low.
19B**:												
Belfield---------	C	None--------	---	---	>6.0	---	---	>60	---	Low------	High-----	Low.
Morton-----------	B	None--------	---	---	>6.0	---	---	20-40	Soft	Moderate	Moderate	Low.
21B, 21C---------- Cherry	C	None--------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Low.
22---------------- Colvin	C	Frequent----	Long------	Apr-Jun	0-2.0	Apparent	Apr-Jul	>60	---	High-----	High-----	Moderate.
24*--------------- Dimmick	D	None--------	---	---	+1-2.0	Apparent	Apr-Jul	>60	---	Moderate	High-----	Low.
25F**:												
Baahish----------	B	None--------	---	---	>6.0	---	---	>60	---	Low------	High-----	Low.
Rock outcrop.												
27, 27B----------- Farland	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Moderate.
29B**:												
Farland----------	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Moderate.
Rhoades----------	D	None--------	---	---	>6.0	---	---	>40	Soft	Low------	High-----	Low.
30E**:												
Cohagen----------	D	None--------	---	---	>6.0	---	---	10-20	Soft	Moderate	Moderate	Low.
Vebar------------	B	None--------	---	---	>6.0	---	---	20-40	Soft	Low------	Moderate	Low.
31F**:												
Cohagen----------	D	None--------	---	---	>6.0	---	---	10-20	Soft	Moderate	Moderate	Low.
Vebar------------	B	None--------	---	---	>6.0	---	---	20-40	Soft	Low------	Moderate	Low.
Rock outcrop.												
32B**, 32C**:												
Flaxton----------	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Low.
Williams---------	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Low.
33, 33B----------- Grail	C	None--------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Low.
35, 35B----------- Lawther	D	None--------	---	---	>6.0	---	---	>60	---	Low------	High-----	Moderate.

See footnotes at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hardness	Potential frost action	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In				
37*------------------- Trembles Variant	B	Frequent----	Very long	Apr-Aug	+3-1.5	Apparent	Apr-Oct	>60	---	Moderate	High-----	Low.
39------------------- Havrelon	B	Occasional	Brief-----	Apr-Jun	4.0-6.0	Apparent	Apr-Jun	>60	---	Moderate	High-----	Low.
40------------------- Havrelon	B	Frequent----	Brief-----	Apr-Jun	4.0-6.0	Apparent	Apr-Jun	>60	---	Moderate	High-----	Low.
41*------------------- Heil	D	None--------	---	---	+1-1.0	Apparent	Mar-Sep	>60	---	Moderate	High-----	Moderate.
42B, 42C---------- Lefor	B	None--------	---	---	>6.0	---	---	20-40	Soft	Moderate	Moderate	Low.
43B------------------- Havrelon	B	Occasional	Brief-----	Apr-Jun	>6.0	---	---	>60	---	Moderate	High-----	Low.
44B, 44D---------- Lihen	A	None--------	---	---	>6.0	---	---	>60	---	Low------	High-----	Low.
45B, 45C---------- Ruso	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Moderate	Low.
46, 46B----------- Bowdle	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Moderate	Low.
47, 47B, 47C------ Moreau	D	None--------	---	---	>6.0	---	---	20-40	Soft	Low------	Moderate	Low.
48B------------------- Temvik	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	High-----	Low.
49, 49B, 49C------ Morton	B	None--------	---	---	>6.0	---	---	20-40	Soft	Moderate	Moderate	Low.
51C------------------- Amor	B	None--------	---	---	>6.0	---	---	20-40	Soft	Moderate	High-----	Moderate.
52B**, 52C**:												
Morton-----------	B	None--------	---	---	>6.0	---	---	20-40	Soft	Moderate	Moderate	Low.
Rhoades----------	D	None--------	---	---	>6.0	---	---	>40	Soft	Low------	High-----	Low.
53B------------------- Watrous	B	None--------	---	---	>6.0	---	---	20-40	Hard	Moderate	High-----	Low.
54B------------------- Parshall	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
55**. Pits												

See footnotes at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
58, 58B, 58C------ Regent	C	None---------	---	---	>6.0	---	---	20-40	Soft	Low-------	High------	Moderate.
61B**, 61C**:												
Regent------------	C	None---------	---	---	>6.0	---	---	20-40	Soft	Low-------	High------	Moderate.
Rhoades-----------	D	None---------	---	---	>6.0	---	---	>40	Soft	Low-------	High------	Low.
62B--------------- Rhoades	D	None---------	---	---	>6.0	---	---	>40	Soft	Low-------	High------	Low.
62D**:												
Rhoades-----------	D	None---------	---	---	>6.0	---	---	>40	Soft	Low-------	High------	Low.
Cabba-------------	C	None---------	---	---	>6.0	---	---	10-20	Soft	Moderate	High------	Low.
64**. Badland												
67, 67B----------- Savage	C	None---------	---	---	>6.0	---	---	>60	---	Low-------	High------	Moderate.
68---------------- Vanda	D	None---------	---	---	>6.0	---	---	>60	---	Low-------	High------	Moderate.
69B**:												
Savage------------	C	None---------	---	---	>6.0	---	---	>60	---	Low-------	High------	Moderate.
Rhoades-----------	D	None---------	---	---	>6.0	---	---	>40	Soft	Low-------	High------	Low.
70C--------------- Searing	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	High------	Moderate.
71B, 71C---------- Sen	B	None---------	---	---	>6.0	---	---	20-40	Soft	Moderate	High------	Moderate.
73C**:												
Cherry------------	C	None---------	---	---	>6.0	---	---	>60	---	Moderate	High------	Low.
Vanda-------------	D	None---------	---	---	>6.0	---	---	>60	---	Low-------	High------	Moderate.
75---------------- Straw	B	Occasional	Brief-----	Mar-May	>6.0	---	---	>60	---	Moderate	High------	Moderate.
79---------------- Velva	B	Occasional	Very brief to brief.	Mar-Jun	>6.0	---	---	>60	---	Moderate	High------	Low.
81B**, 81C**:												
Vebar-------------	B	None---------	---	---	>6.0	---	---	20-40	Soft	Low-------	Moderate	Low.
Parshall----------	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
81D, 82D---------- Vebar	B	None---------	---	---	>6.0	---	---	20-40	Soft	Low-------	Moderate	Low.

See footnotes at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
83E----------------- Baahish	B	None---------	---	---	>6.0	---	---	>60	---	Low-------	High------	Low.
84, 84B------------- Hidatsa	B	None---------	---	---	>6.0	---	---	>60	---	Low-------	High------	Low.
86F**:												
Brandenburg--------	A	None---------	---	---	>6.0	---	---	>60	---	Low-------	High------	Moderate.
Cabba--------------	C	None---------	---	---	>6.0	---	---	10-20	Soft	Moderate	High------	Low.
87F----------------- Lakoa	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	High------	Moderate.
88, 88B, 88C, 90C- Williams	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	High------	Low.
91B**, 91C**:												
Williams-----------	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	High------	Low.
Noonan-------------	D	None---------	---	---	>6.0	---	---	>60	---	Moderate	High------	Moderate.
93C**:												
Williams-----------	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	High------	Low.
Zahl---------------	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
93D**, 93E**:												
Zahl---------------	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
Williams-----------	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	High------	Low.
94B----------------- Moreau Variant	D	None---------	---	---	>6.0	---	---	10-20	Soft	Low-------	High------	Moderate.
94E----------------- Wayden	D	None---------	---	---	>6.0	---	---	10-20	Soft	Low-------	High------	Moderate.
101B, 101C---------- Amor	B	None---------	---	---	>6.0	---	---	20-40	Soft	Moderate	High------	Moderate.
102, 102B----------- Shambo	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Moderate	Low.
105----------------- Harriet	D	Occasional	Long------	Apr-Jun	0-1.0	Apparent	Sep-Jun	>60	---	High------	High------	Moderate.
106B---------------- Daglum	D	None---------	---	---	>6.0	---	---	40-60	Soft	Moderate	High------	Low.
107**. Aquents												

See footnotes at end of table.

TABLE 16.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock		Potential frost action	Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness		Uncoated steel	Concrete
					Ft			In				
109B---------------- Ekalaka	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	High------	Moderate.
207F---------------- Arikara	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	High------	Moderate.
209E**:												
Cherry------------	C	None---------	---	---	>6.0	---	---	>60	---	Moderate	High------	Low.
Cabba--------------	C	None---------	---	---	>6.0	---	---	10-20	Soft	Moderate	High------	Low.
211F**: Badland.												
Cabba--------------	C	None---------	---	---	>6.0	---	---	10-20	Soft	Moderate	High------	Low.
Arikara------------	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	High------	Moderate.

* In the "High water table--Depth" column, a plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

** See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--ENGINEERING INDEX TEST DATA

[Dashes indicate data were not available.]

Soil name, report number, horizon, and depth in inches	Classification		Grain size distribution								Liquid limit	Plasticity index	Moisture density	
			Percentage passing sieve					Percentage smaller than--						
	AASHTO	Unified	3/8 inch	No. 4	No. 10	No. 40	No. 200	.02 mm	.005 mm	.002 mm			Moisture density	Optimum moisture
											Pct		Lb/ft3	Pct
Baahish fine sandy loam: (S78ND-025-001)														
B2------ 3 to 13	A-2-6(04)	SC	91	87	79	69	33	--	11	--	33	12	120	13
IIC1ca-- 13 to 28	A-1-B(00)	SM-SC	73	61	52	42	24	--	6	--	23	5	126	10
Belfield silty clay loam: (S76ND-025-004)														
B2t----- 14 to 25	A-7-6(16)	CH	100	100	100	100	93	--	35	--	51	25	108	17
C1sa---- 30 to 39	A-6(12)	CL	100	100	100	100	85	--	41	--	37	19	118	14
Grail silt loam: (S77ND-025-057)														
B2t----- 11 to 20	A-7-6(09)	ML	100	100	100	100	89	--	39	--	40	13	113	15
C1ca---- 20 to 34	A-7-6(13)	CL	100	100	100	100	93	--	48	--	43	21	112	15
Harriet silt loam: (S74ND-025-007)														
B2t----- 2 to 10	A-7-6(15)	CL	100	100	100	100	86	--	45	--	44	26	115	14
C1cs---- 10 to 30	A-7-6(20)	CH	100	100	100	100	93	--	56	--	61	37	113	15
Hidatsa loam: (S78ND-025-002)														
B22----- 17 to 28	A-4(02)	SC	100	100	99	92	47	--	18	--	25	9	121	12
IIC1---- 28 to 44	A-1-B(00)	SM-SC	76	61	47	37	17	--	05	--	22	4	126	10
Lefor fine sandy loam: (S77ND-025-006)														
B1------- 8 to 19	A-4(01)	SM-SC	100	100	100	96	42	--	18	--	18	5	112	15
B2t----- 19 to 28	A-4(03)	SC	100	100	100	96	49	--	30	--	22	7	127	10
Morton silt loam: (S77ND-025-054)														
B2t---- 10 to 22	A-6(09)	CL	100	100	100	100	93	--	32	--	37	13	113	15
Cca---- 22 to 36	A-7-6(12)	CL	100	100	100	100	93	--	38	--	40	19	118	14
Savage silty clay loam: (S76ND-025-010)														
B2t----- 5 to 13	A-7-6(13)	CL	100	100	100	99	86	--	50	--	44	19	116	14
C1ca--- 28 to 42	A-6(12)	CL	100	100	99	98	85	--	51	--	37	20	121	12

TABLE 18.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Amor	Fine-loamy, mixed Typic Haploborolls
Aquents	Fine, montmorillonitic, frigid Aquents
Arikara	Fine-loamy, mixed, frigid Typic Eutrochrepts
Arnegard	Fine-loamy, mixed Pachic Haploborolls
Baahish	Loamy-skeletal, mixed Entic Haploborolls
Banks	Sandy, mixed, frigid Typic Ustifluvents
Belfield	Fine, montmorillonitic Glossic Natriborolls
Bowdle	Fine-loamy over sandy or sandy-skeletal, mixed Pachic Haploborolls
Brandenburg	Fragmental, mixed, frigid Typic Ustorthents
Cabba	Loamy, mixed (calcareous), frigid, shallow Typic Ustorthents
Chama	Fine-silty, mixed Entic Haploborolls
Cherry	Fine-silty, mixed, frigid Typic Ustochrepts
Cohagen	Loamy, mixed (calcareous), frigid, shallow Typic Ustorthents
Colvin	Fine-silty, frigid Typic Calciaquolls
Daglum	Fine, montmorillonitic Typic Natriborolls
Dimmick	Fine, montmorillonitic, frigid Typic Haplaquolls
Ekalaka	Coarse-loamy, mixed Typic Natriborolls
Farland	Fine-silty, mixed Typic Argiborolls
Flaxton	Fine-loamy, mixed Pachic Argiborolls
Grail	Fine, montmorillonitic Pachic Argiborolls
Harriet	Fine, mixed, frigid Typic Natraquolls
Havrelon	Fine-loamy, mixed (calcareous), frigid Typic Ustifluvents
Heil	Fine, montmorillonitic, frigid Typic Natraquolls
Hidatsa	Loamy-skeletal, mixed Pachic Haploborolls
Lakoa	Fine-loamy, mixed Typic Eutroboralfs
Lawther	Fine, montmorillonitic Vertic Haploborolls
*Lefor	Fine-loamy, mixed Typic Argiborolls
Lihen	Sandy, mixed Entic Haploborolls
*Moreau	Fine, montmorillonitic Typic Haploborolls
Moreau Variant	Clayey, mixed, frigid, shallow Typic Ustochrepts
Morton	Fine-silty, mixed Typic Argiborolls
Noonan	Fine-loamy, mixed Typic Natriborolls
Parshall	Coarse-loamy, mixed Pachic Haploborolls
Regent	Fine, montmorillonitic Typic Argiborolls
Rhoades	Fine, montmorillonitic Leptic Natriborolls
Ruso	Coarse-loamy, mixed Pachic Haploborolls
Savage	Fine, montmorillonitic Typic Argiborolls
Searing	Fine-loamy over fragmental, mixed Typic Haploborolls
Sen	Fine-silty, mixed Typic Haploborolls
Shambo	Fine-loamy, mixed Typic Haploborolls
Straw	Fine-loamy, mixed Cumulic Haploborolls
Temvik	Fine-silty, mixed Typic Haploborolls
Tonka	Fine, montmorillonitic, frigid Argiaquic Argialbolls
Trembles Variant	Coarse-loamy, mixed (calcareous), frigid Aeric Fluvaquents
Vanda	Fine, montmorillonitic (calcareous), frigid Ustic Torriorthents
Vebar	Coarse-loamy, mixed Typic Haploborolls
Velva	Coarse-loamy, mixed Fluventic Haploborolls
Wabek	Sandy-skeletal, mixed Entic Haploborolls
Watrous	Fine-loamy, mixed Typic Argiborolls
Wayden	Clayey, montmorillonitic (calcareous), frigid, shallow Typic Ustorthents
Williams	Fine-loamy, mixed Typic Argiborolls
Zahl	Fine-loamy, mixed Entic Haploborolls

* The soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series.

☆ U.S. GOVERNMENT PRINTING OFFICE: 1982—355-098 1108

NRCS Accessibility Statement

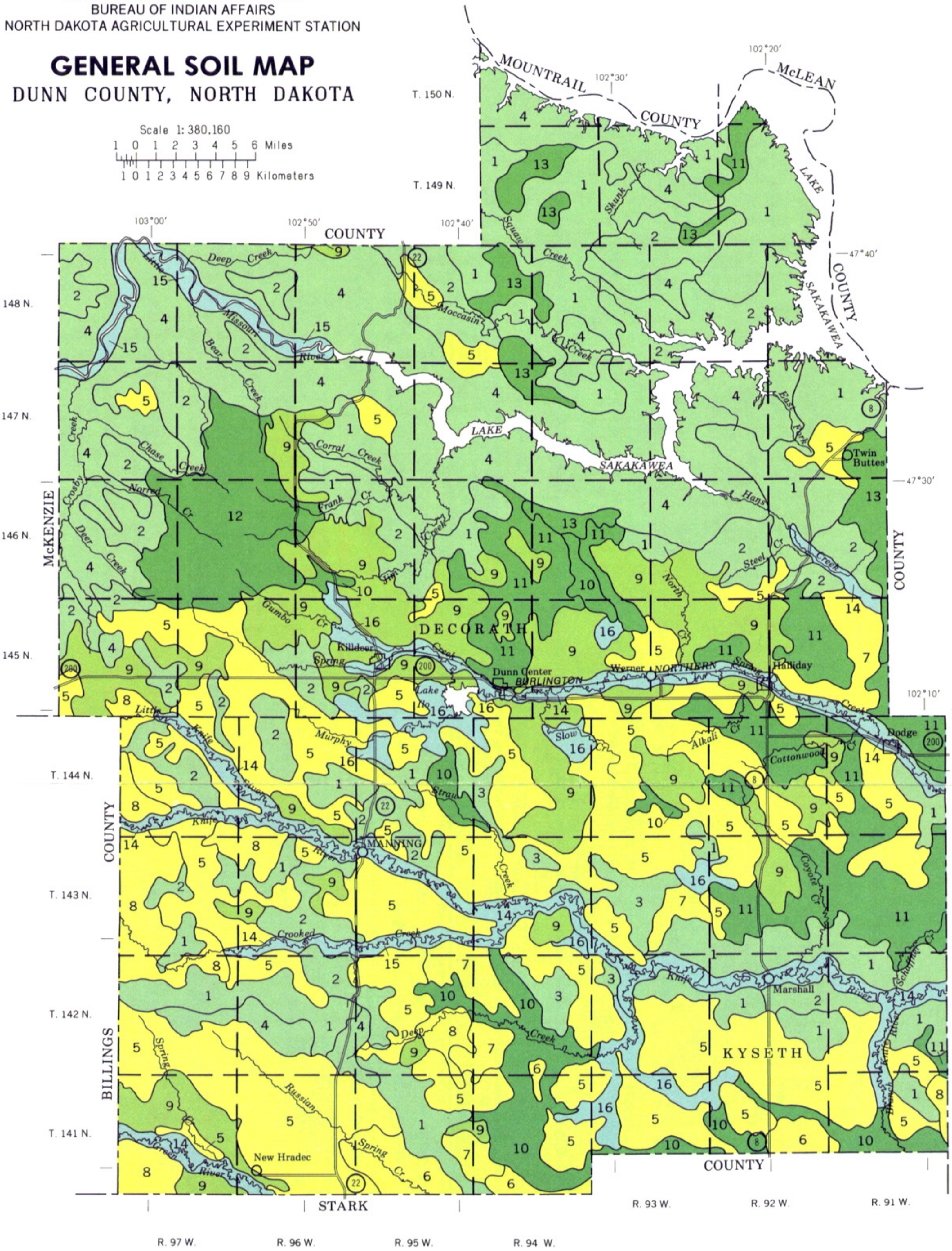
This document is not accessible by screen-reader software. The Natural Resources Conservation Service (NRCS) is committed to making its information accessible to all of its customers and employees. If you are experiencing accessibility issues and need assistance, please contact our Helpdesk by phone at 1-800-457-3642 or by e-mail at ServiceDesk-FTC@ftc.usda.gov. For assistance with publications that include maps, graphs, or similar forms of information, you may also wish to contact our State or local office. You can locate the correct office and phone number at http://offices.sc.egov.usda.gov/locator/app.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF INDIAN AFFAIRS
NORTH DAKOTA AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP
DUNN COUNTY, NORTH DAKOTA

Scale 1:380,160



SOIL LEGEND*

DOMINANTLY SHALLOW, NEARLY LEVEL TO VERY STEEP SOILS ON UPLANDS

1 — Cabba-Cohagen-Rhoades association: Well drained, somewhat excessively drained, and moderately well drained, shallow and deep, moderately coarse textured and medium textured soils which formed in material weathered from siltstone and sandstone or which formed in alluvium

2 — Cohagen-Vebar association: Somewhat excessively drained and well drained, shallow and moderately deep, moderately coarse textured soils that formed in material weathered from sandstone

3 — Cabba-Brandenburg-Rhoades association: Well drained, excessively drained, and moderately well drained, shallow and deep, medium textured soils which formed in material weathered from siltstone or porcelanite or which formed in alluvium

4 — Cabba-Badland-Cherry association: Well drained, shallow and deep, medium textured and moderately fine textured soils which formed in material weathered from siltstone or which formed in alluvium; and badland

DOMINANTLY MODERATELY DEEP, NEARLY LEVEL TO STEEP SOILS ON UPLANDS

5 — Morton-Rhoades-Savage association: Well drained and moderately well drained, moderately deep and deep, medium textured and moderately fine textured soils which formed in material weathered from shale and siltstone or which formed in alluvium

6 — Regent-Morton-Savage association: Well drained, moderately deep and deep, moderately fine textured and medium textured soils which formed in material weathered from shale and siltstone or which formed in alluvium

7 — Sen-Chama-Cabba association: Well drained, moderately deep and shallow, medium textured soils that formed in material weathered from siltstone

8 — Moreau-Rhoades association: Well drained and moderately well drained, moderately deep and deep, fine textured and medium textured soils which formed in material weathered from shale or which formed in alluvium

DOMINANTLY MODERATELY DEEP, NEARLY LEVEL TO STRONGLY SLOPING SOILS ON UPLANDS AND TERRACES

9 — Vebar-Parshall association: Well drained, moderately deep and deep, moderately coarse textured soils which formed in material weathered from sandstone or which formed in alluvium

DOMINANTLY DEEP, NEARLY LEVEL TO VERY STEEP SOILS ON TERRACES, UPLANDS, AND FANS

10 — Savage-Lawther-Rhoades association: Well drained and moderately well drained, deep, medium to fine textured soils that formed in alluvium and clayey sediment

11 — Williams-Amor-Arnegard association: Well drained, deep and moderately deep, medium textured soils which formed in glacial till or alluvium or which formed in material weathered from sandstone and siltstone

12 — Baahish-Lakoa-Hidatsa association: Somewhat excessively drained and well drained, deep, moderately coarse textured and medium textured soils which formed in alluvium over gravelly outwash or which formed in material weathered from sandstone and shale

13 — Williams-Cabba-Zahl association: Well drained, deep and shallow, medium textured soils that formed in glacial till and in material weathered from siltstone

DOMINANTLY DEEP, LEVEL TO GENTLY SLOPING SOILS ON TERRACES, FLOOD PLAINS, FANS, AND UPLANDS

14 — Straw-Velva association: Well drained, deep, medium textured and moderately coarse textured soils that formed in alluvium

15 — Havrelon-Banks-Trembles Variant association: Well drained, somewhat excessively drained, and poorly drained, deep, medium textured, coarse textured, and moderately coarse textured soils that formed in alluvium

16 — Rhoades-Harriet-Dimmick association: Moderately well drained, poorly drained, and very poorly drained, deep, medium textured and fine textured soils that formed in alluvium and clayey sediment

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

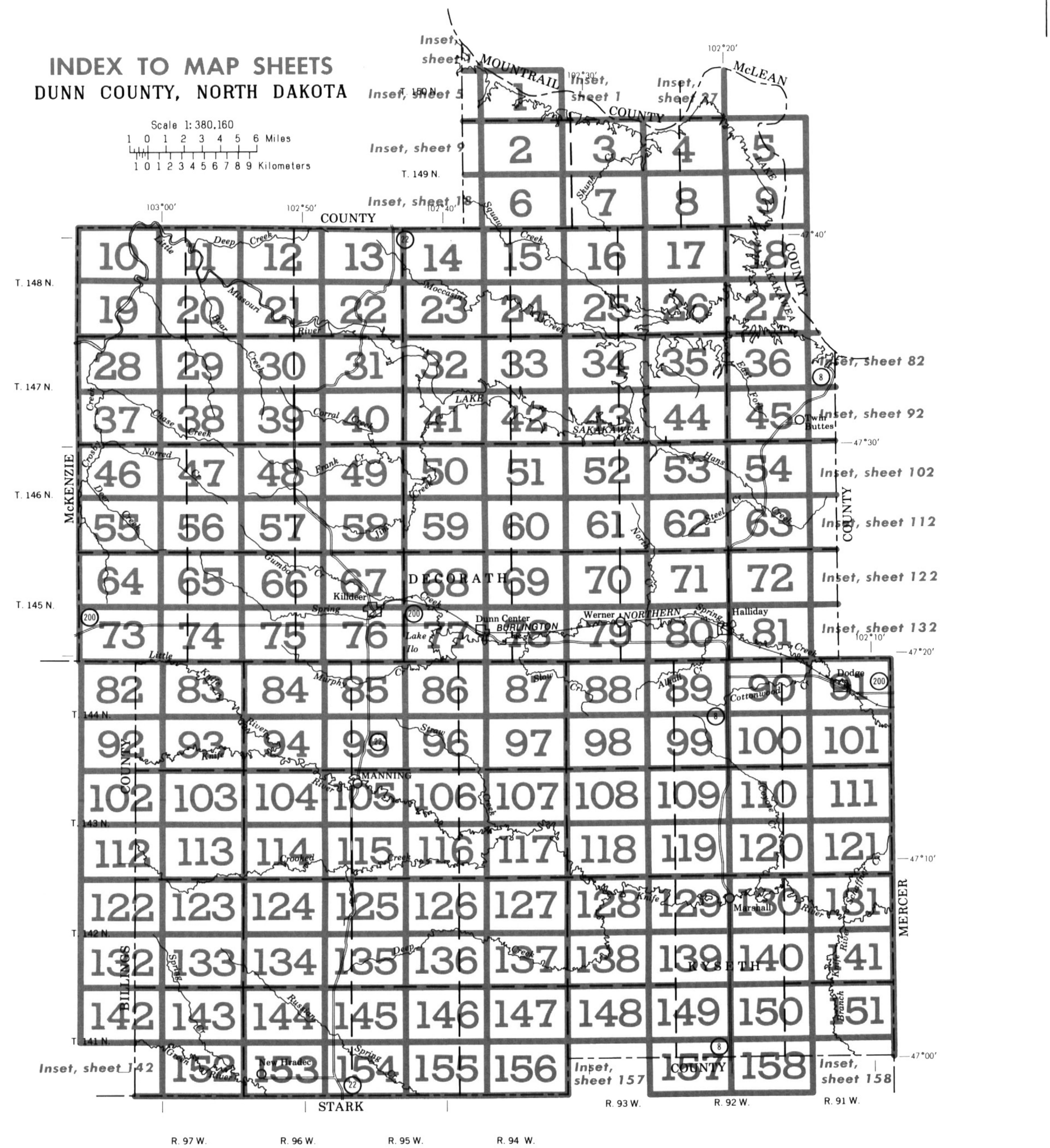
*The texture given in the descriptive heading refers to the texture of the surface layer of the major soils in each map unit.

Compiled 1981

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

INDEX TO MAP SHEETS
DUNN COUNTY, NORTH DAKOTA



SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

SOIL LEGEND

Map symbols consist of numbers or a combination of numbers and letters. The initial numbers represent the kind of soil. A capital letter following these numbers indicates the class of slope. Symbols without a slope letter are for nearly level soils or miscellaneous areas.

SYMBOL	NAME
3	Straw loam, channeled
4	Arnegard loam, 1 to 3 percent slopes
4B	Arnegard loam, 3 to 6 percent slopes
5	Tonka silt loam
7	Straw-Rhoades loam
8C	Cabba-Chama silt loams, 6 to 9 percent slopes
9D	Amor-Cabba loams, 9 to 15 percent slopes
9E	Cabba loam, 15 to 45 percent slopes
10D	Cabba extremely stony loam, 3 to 25 percent slopes
11F	Cabba-Badland complex, 15 to 120 percent slopes
12	Banks loamy sand, 1 to 3 percent slopes
13D	Wabek gravelly loam, 1 to 15 percent slopes
15	Belfield-Farland silt loams, 1 to 3 percent slopes
16B	Belfield-Savage silty clay loams, 1 to 6 percent slopes
18	Belfield-Grail silty clay loams, 1 to 3 percent slopes
19B	Belfield-Morton silt loams, 1 to 6 percent slopes
21B	Cherry silty clay loam, 1 to 6 percent slopes
21C	Cherry silty clay loam, 6 to 9 percent slopes
22	Colvin silt loam, saline
24	Dimmick clay
25F	Baahish-Rock outcrop complex, 15 to 120 percent slopes
27	Farland silt loam, 1 to 3 percent slopes
27B	Farland silt loam, 3 to 6 percent slopes
29B	Farland-Rhoades silt loams, 1 to 6 percent slopes
30E	Cohagen-Vebar fine sandy loams, 9 to 25 percent slopes
31F	Cohagen-Vebar-Rock outcrop complex, 15 to 40 percent slopes
32B	Flaxton-Williams complex, 1 to 6 percent slopes
32C	Flaxton-Williams complex, 6 to 9 percent slopes
33	Grail silt loam, 1 to 3 percent slopes
33B	Grail silt loam, 3 to 6 percent slopes
35	Lawther silty clay, 1 to 3 percent slopes
35B	Lawther silty clay, 3 to 6 percent slopes
37	Trembles Variant fine sandy loam
39	Havrelon silt loam
40	Havrelon silt loam, channeled
41	Heil silty clay loam
42B	Lefor fine sandy loam, 1 to 6 percent slopes
42C	Lefor fine sandy loam, 6 to 9 percent slopes
43B	Havrelon silt loam, fan, 1 to 6 percent slopes
44B	Lihen loamy fine sand, 1 to 6 percent slopes
44D	Lihen loamy fine sand, 6 to 15 percent slopes
45B	Ruso sandy loam, 1 to 6 percent slopes
45C	Ruso sandy loam, 6 to 9 percent slopes
46	Bowdle loam, 1 to 3 percent slopes
46B	Bowdle loam, 3 to 6 percent slopes
47	Moreau silty clay, 1 to 3 percent slopes
47B	Moreau silty clay, 3 to 6 percent slopes
47C	Moreau silty clay, 6 to 9 percent slopes
48B	Temvik silt loam, 3 to 6 percent slopes
49	Morton silt loam, 1 to 3 percent slopes
49B	Morton silt loam, 3 to 6 percent slopes
49C	Morton silt loam, 6 to 9 percent slopes
51C	Amor extremely stony loam, 1 to 9 percent slopes
52B	Morton-Rhoades silt loams, 1 to 6 percent slopes
52C	Morton-Rhoades silt loams, 6 to 9 percent slopes
53B	Watrous loam, 1 to 6 percent slopes
54B	Parshall fine sandy loam, 1 to 6 percent slopes
55	Pits
58	Regent silty clay loam, 1 to 3 percent slopes
58B	Regent silty clay loam, 3 to 6 percent slopes
58C	Regent silty clay loam, 6 to 9 percent slopes
61B	Regent-Rhoades silty clay loams, 1 to 6 percent slopes
61C	Regent-Rhoades silty clay loams, 6 to 9 percent slopes
62B	Rhoades silt loam, 1 to 6 percent slopes
62D	Rhoades-Cabba loams, 9 to 15 percent slopes
64	Badland
67	Savage silty clay loam, 1 to 3 percent slopes
67B	Savage silty clay loam, 3 to 6 percent slopes
68	Vanda silty clay, 1 to 3 percent slopes
69B	Savage-Rhoades silty clay loams, 1 to 6 percent slopes
70C	Searing loam, 3 to 9 percent slopes
71B	Sen silt loam, 3 to 6 percent slopes
71C	Sen silt loam, 6 to 9 percent slopes
73C	Cherry-Vanda complex, 3 to 9 percent slopes, gullied
75	Straw loam
79	Velva fine sandy loam, 1 to 3 percent slopes
81B	Vebar-Parshall fine sandy loams, 1 to 6 percent slopes
81C	Vebar-Parshall fine sandy loams, 6 to 9 percent slopes
81D	Vebar fine sandy loam, 9 to 15 percent slopes
82D	Vebar extremely stony fine sandy loam, 3 to 15 percent slopes
83E	Baahish fine sandy loam, 9 to 50 percent slopes
84	Hidatsa loam, 1 to 3 percent slopes
84B	Hidatsa loam, 3 to 6 percent slopes
86F	Brandenburg-Cabba loams, 6 to 50 percent slopes
87F	Lakoa loam, 15 to 45 percent slopes
88	Williams loam, 1 to 3 percent slopes
88B	Williams loam, 3 to 6 percent slopes
88C	Williams loam, 6 to 9 percent slopes
90C	Williams extremely stony loam, 1 to 9 percent slopes
91B	Williams-Noonan loams, 3 to 6 percent slopes
91C	Williams-Noonan loams, 6 to 9 percent slopes
93C	Williams-Zahl loams, 6 to 9 percent slopes
93D	Zahl-Williams loams, 9 to 15 percent slopes
93E	Zahl-Williams loams, 15 to 25 percent slopes
94B	Moreau Variant clay loam, 1 to 6 percent slopes
94E	Wayden silty clay, 9 to 25 percent slopes
101B	Amor loam, 3 to 6 percent slopes
101C	Amor loam, 6 to 9 percent slopes
102	Shambo loam, 1 to 3 percent slopes
102B	Shambo loam, 3 to 6 percent slopes
105	Harriet silt loam
106B	Daglum silt loam, 1 to 6 percent slopes
107	Aquents, ponded
109B	Ekalaka fine sandy loam, 1 to 6 percent slopes
207F	Arikara loam, 9 to 75 percent slopes
209E	Cherry-Cabba complex, 9 to 25 percent slopes
211F	Badland-Cabba-Arikara complex, 25 to 120 percent slopes

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline & neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool — Davis Airstrip; FLOOD POOL LINE

STATE COORDINATE TICK

LAND DIVISION CORNERS (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEMS & DESIGNATIONS

- Interstate — 79
- Federal — 410
- State — 52
- County, farm or ranch — 378

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or small — water; w

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label) — Indian Mound
- Located object (label) — Tower
- Tank (label) — GAS
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label) — CANAL
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial — water; w
- Intermittent — int; i

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS — 13D; 101C

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

GULLY

DEPRESSION OR SINK

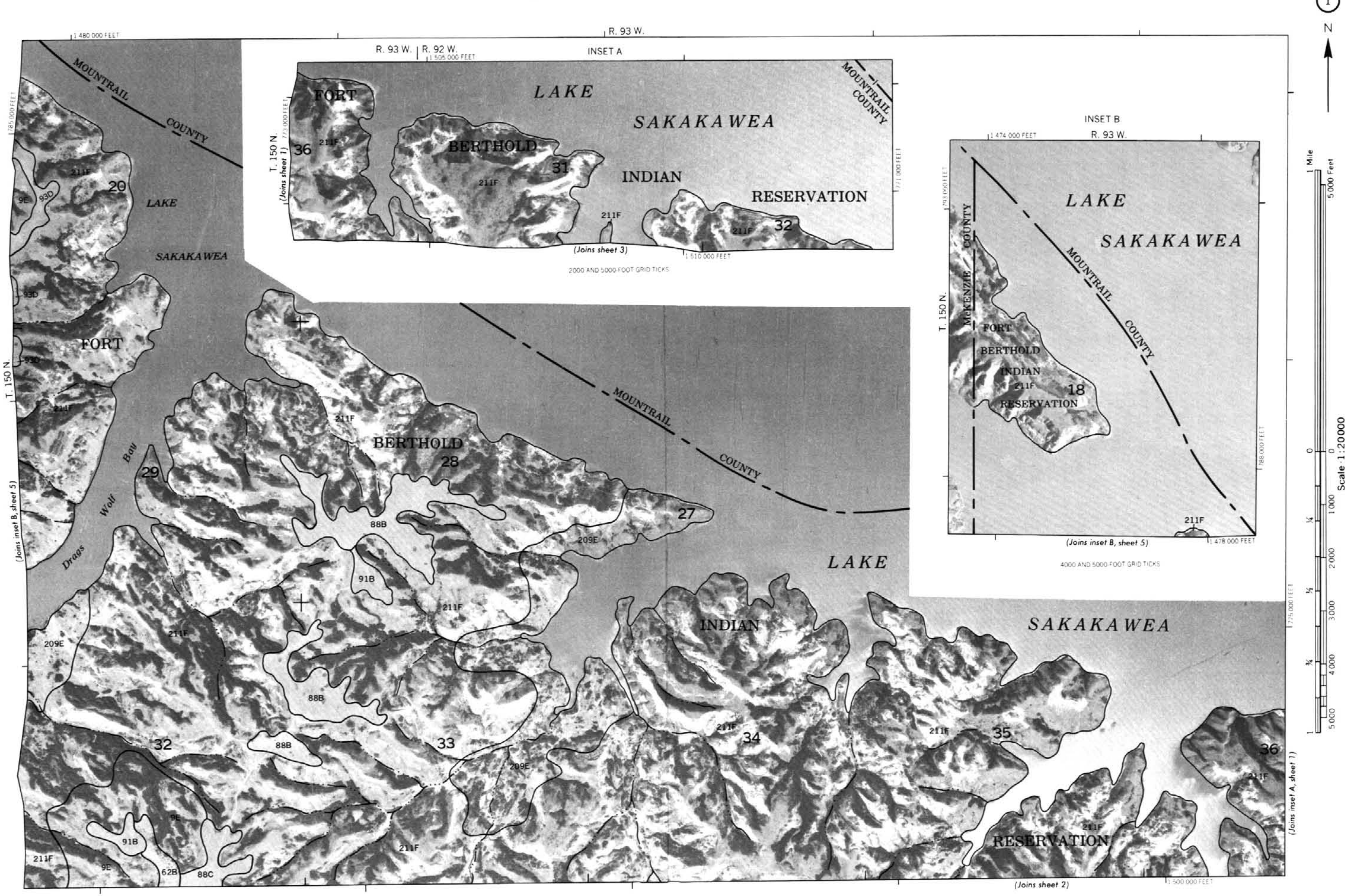
SOIL SAMPLE SITE (normally not shown) — S

MISCELLANEOUS

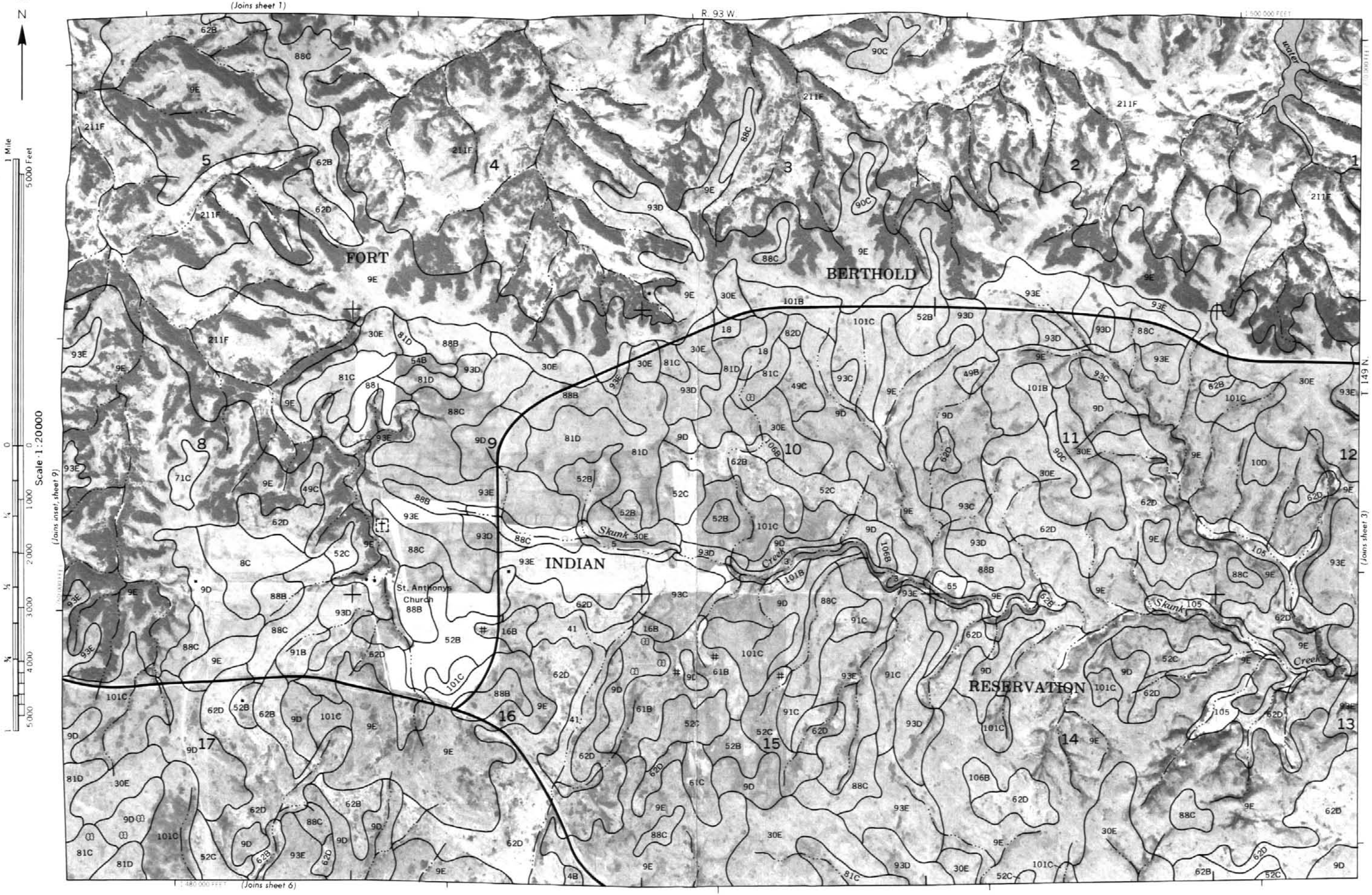
- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot
- Porcelanite outcrop
- Saline seep
- Butte

DUNN COUNTY, NORTH DAKOTA NO. 1

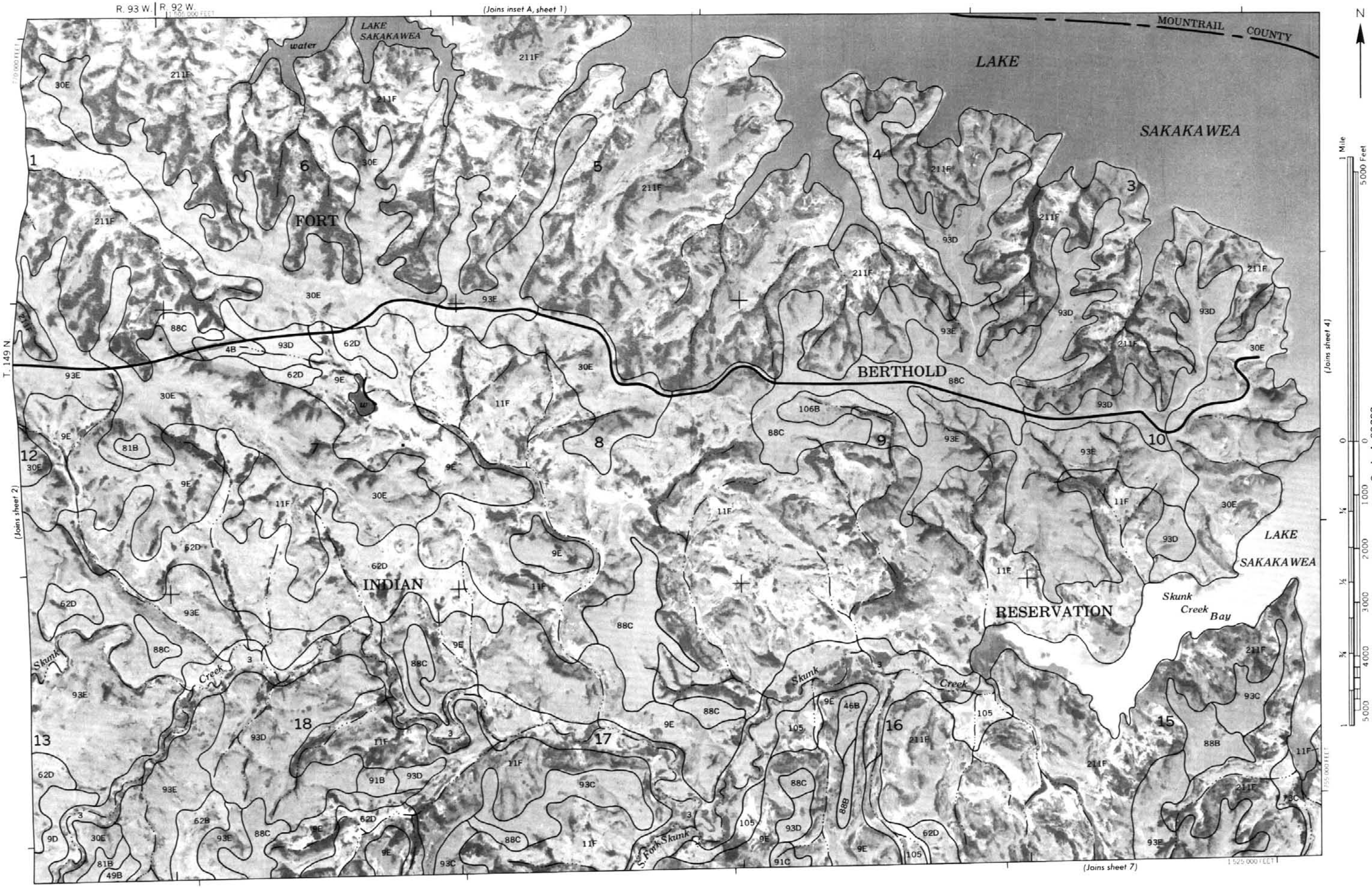
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



2

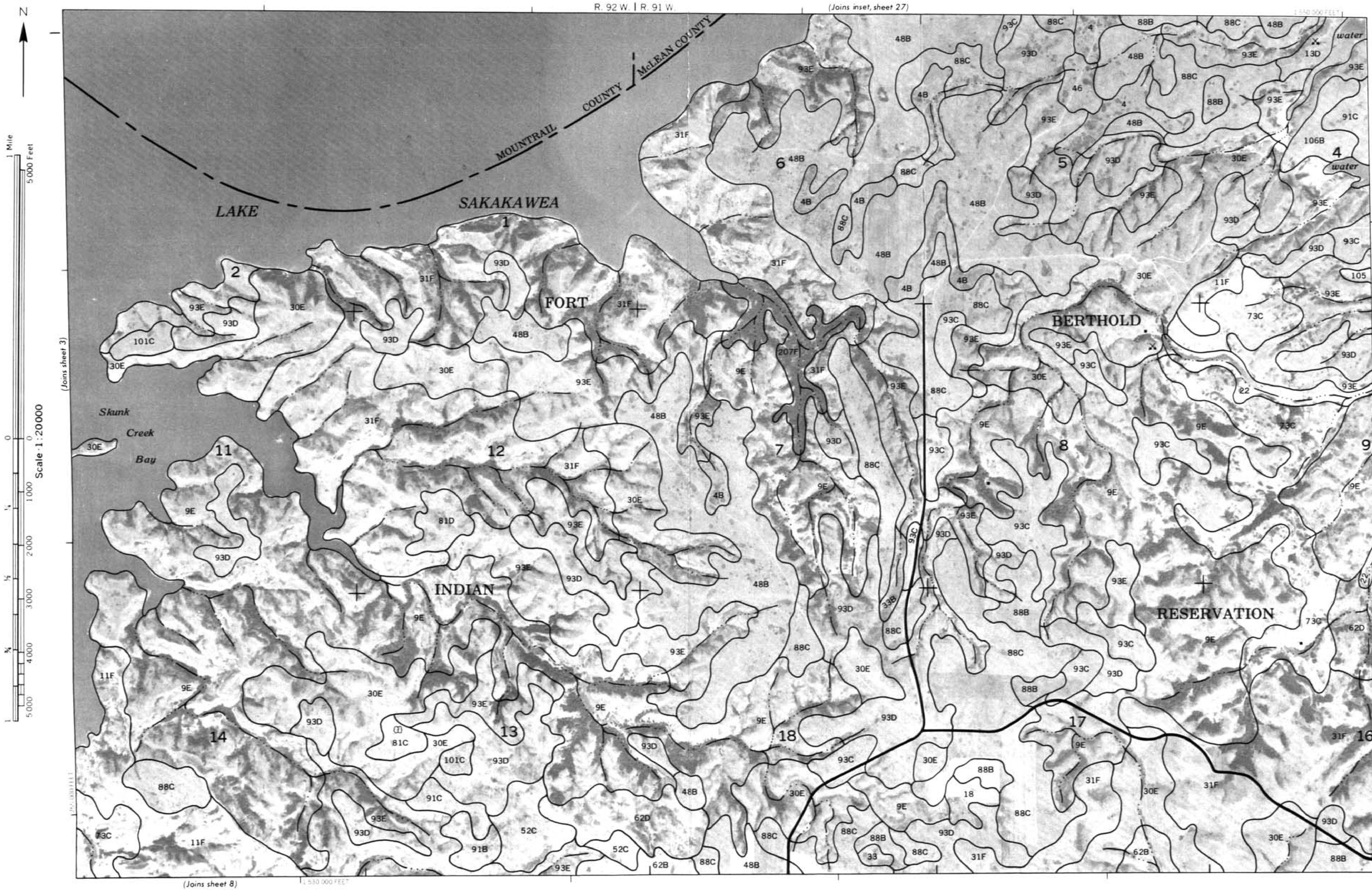


DUNN COUNTY, NORTH DAKOTA NO. 2



DUNN COUNTY, NORTH DAKOTA NO. 3

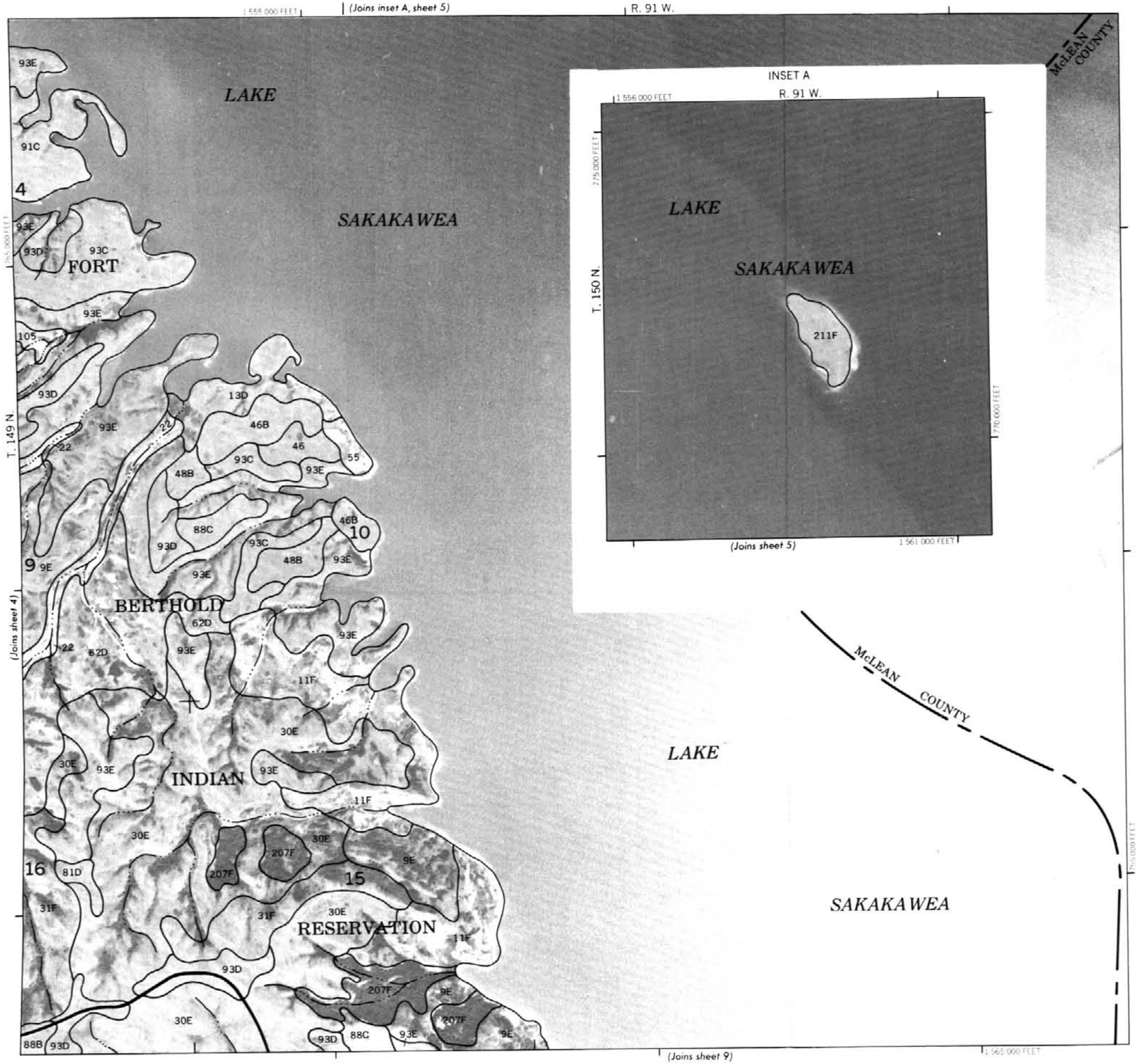
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DUNN COUNTY, NORTH DAKOTA NO. 4

5



N

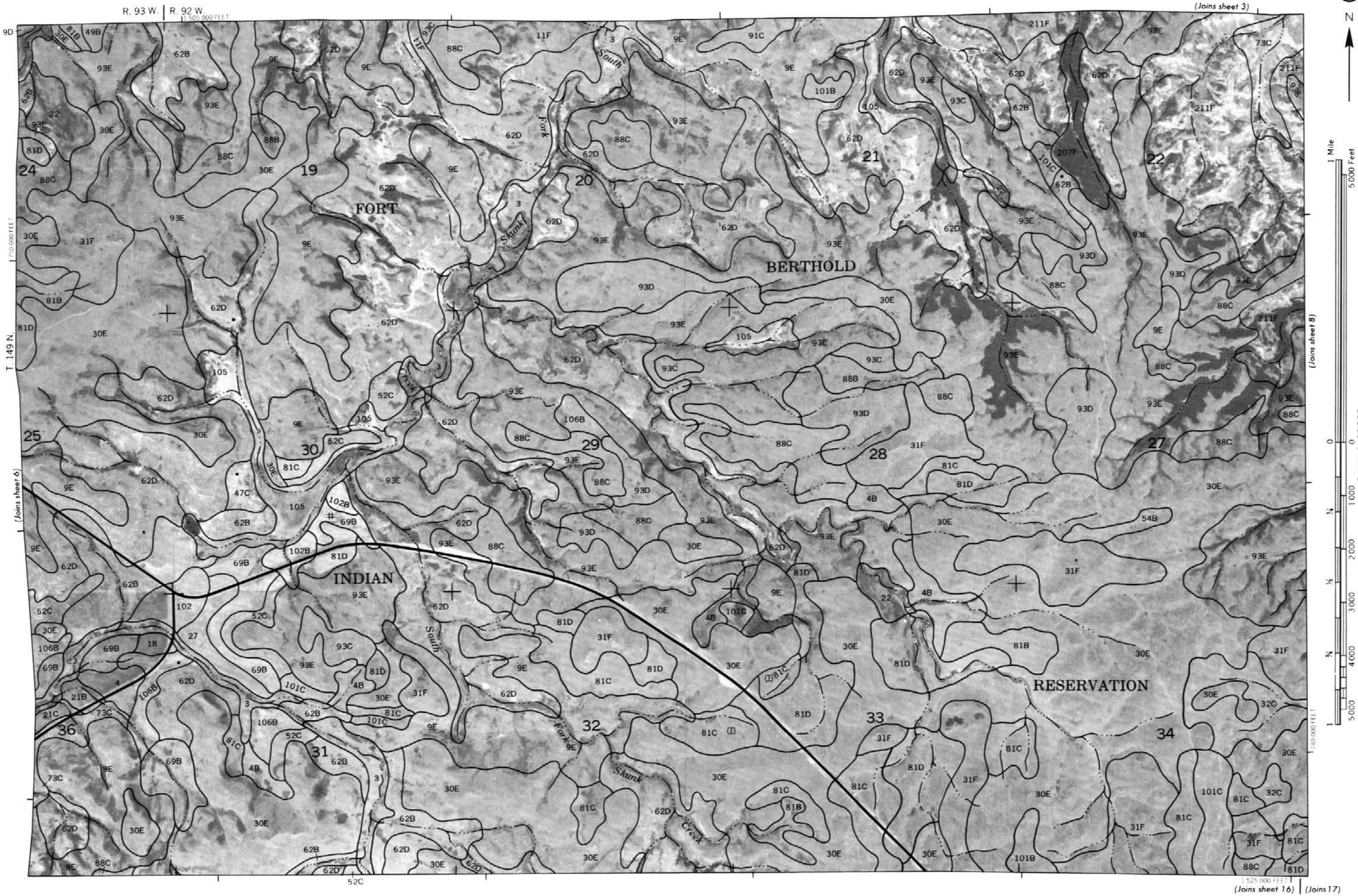
1 Mile
5000 Feet
Scale 1:20000
0 ¼ ½ ¾ 1
0 1000 2000 3000 4000 5000

4000 AND 5000 FOOT GRID TICKS

DUNN COUNTY, NORTH DAKOTA NO. 5

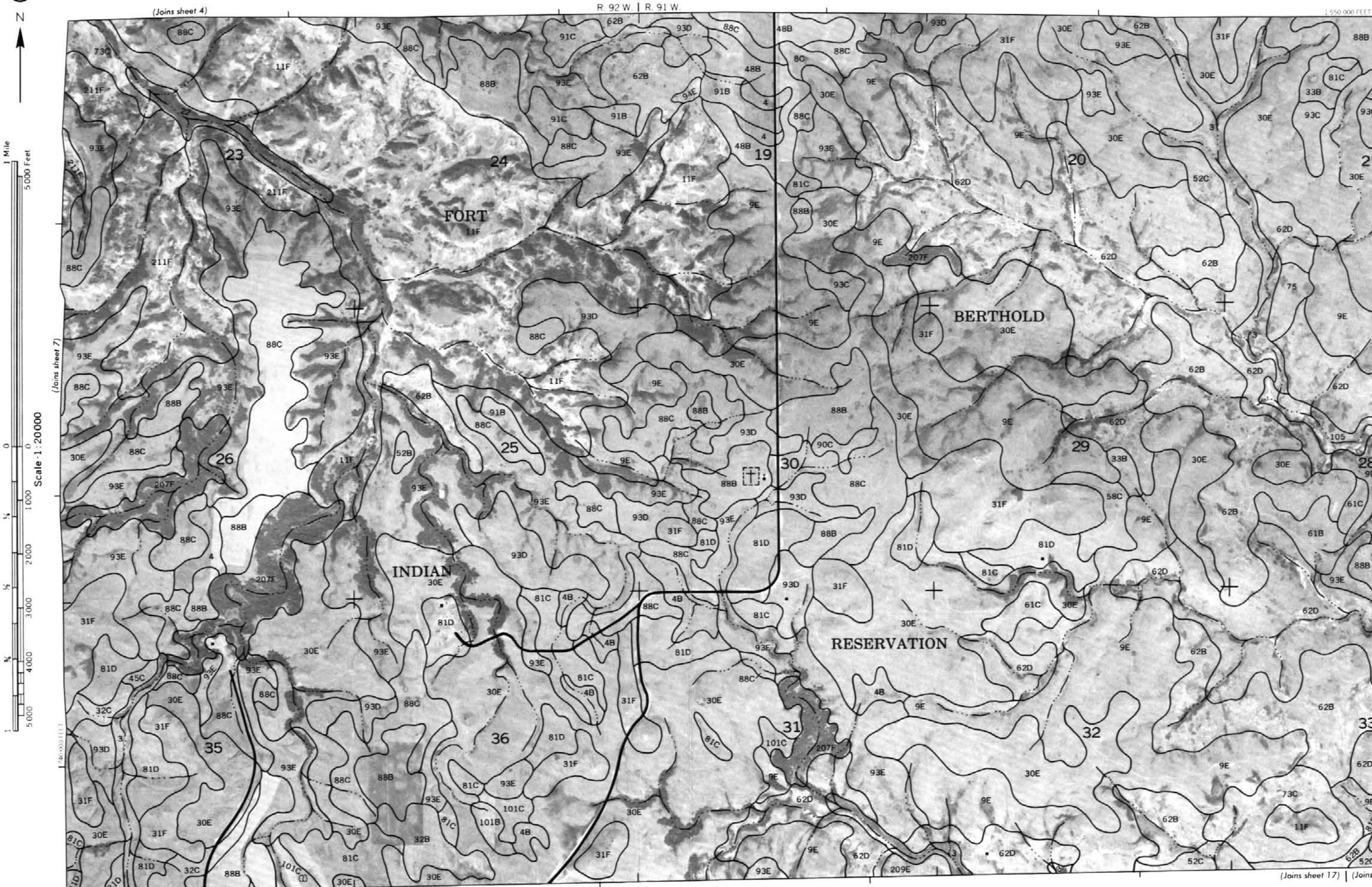
This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.


N
Scale 1:20000
1 Mile
5000 Feet
(Joins sheet 2)
(Joins inset, sheet 18)
(Joins sheet 7)
(Joins sheet 15)
R. 93 W.
T. 149 N.
1 500 000 FEET
1 480 000 FEET
FORT
INDIAN
BERTHOLD
RESERVATION
Squaw
Creek
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36



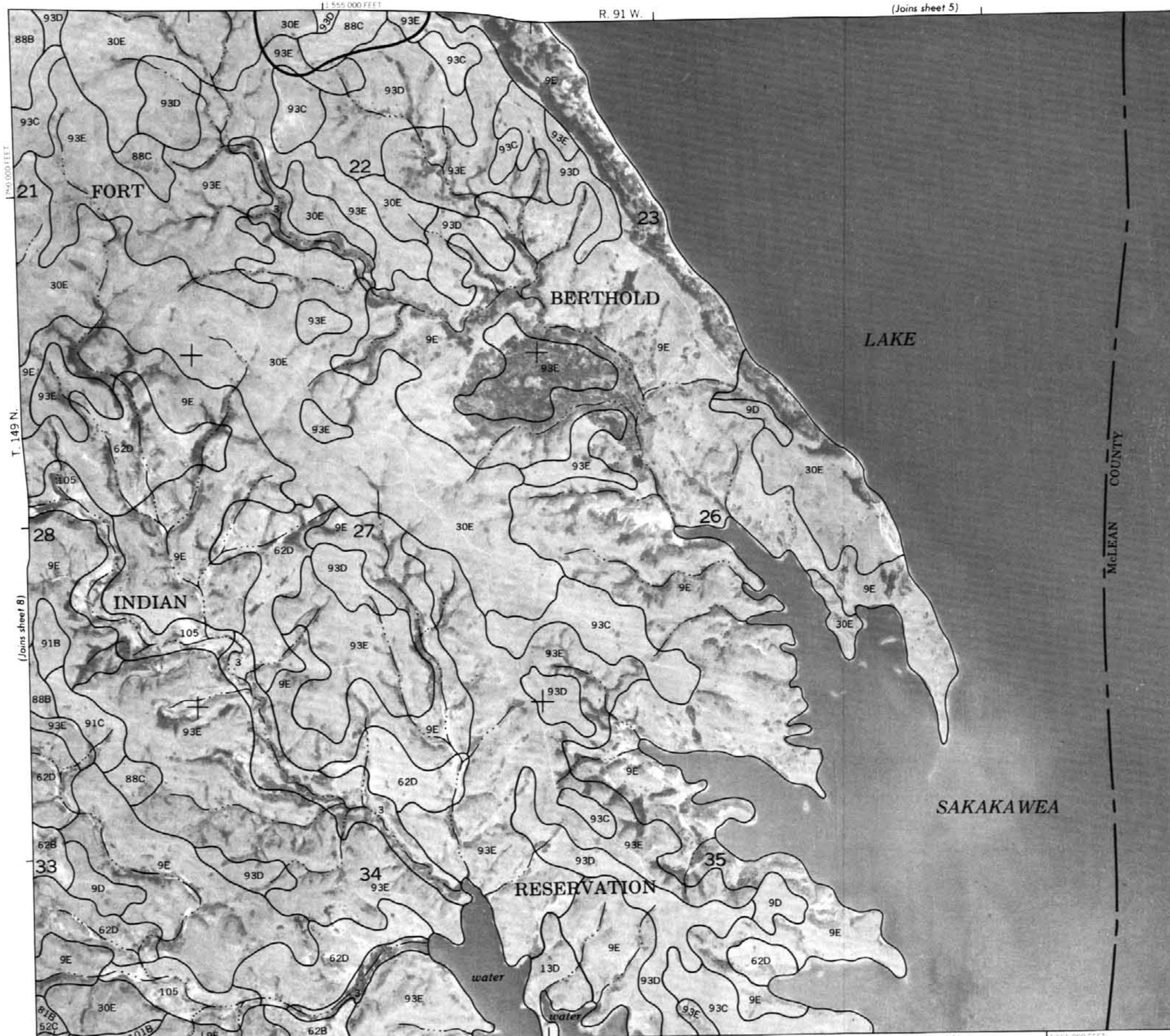
DUNN COUNTY, NORTH DAKOTA NO. 7

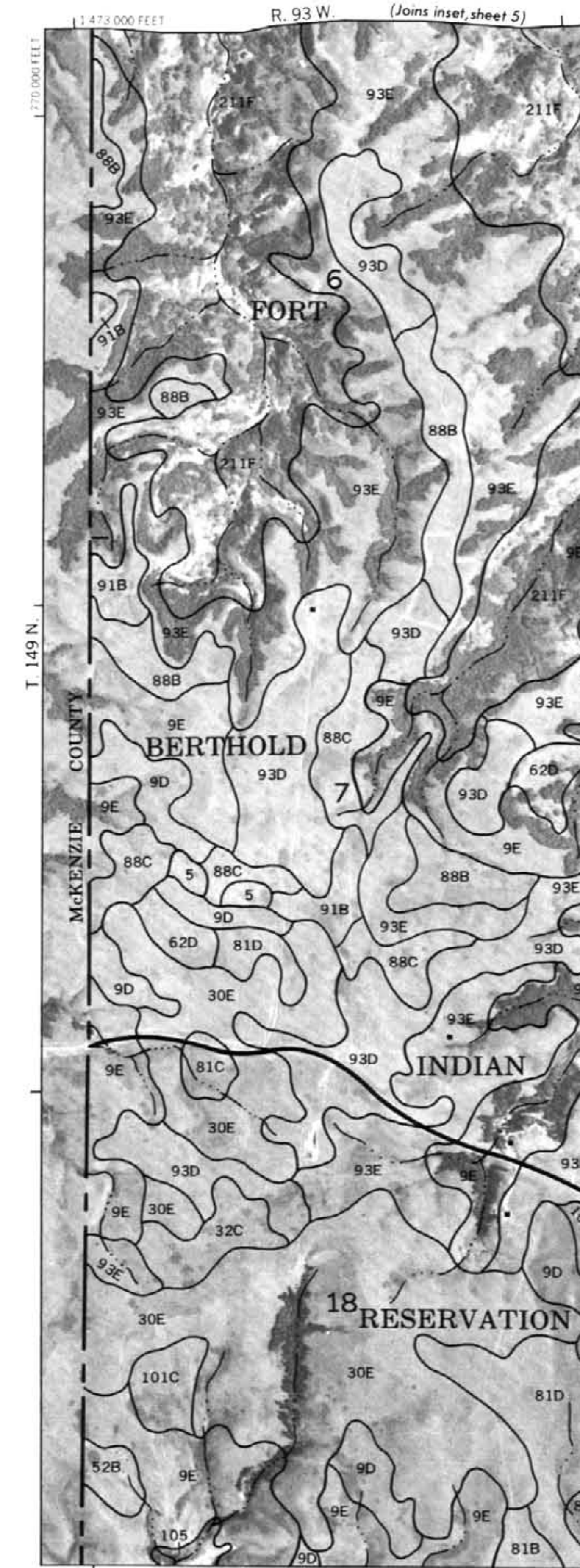
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

(9)





N

1 Mile

5 000 Feet

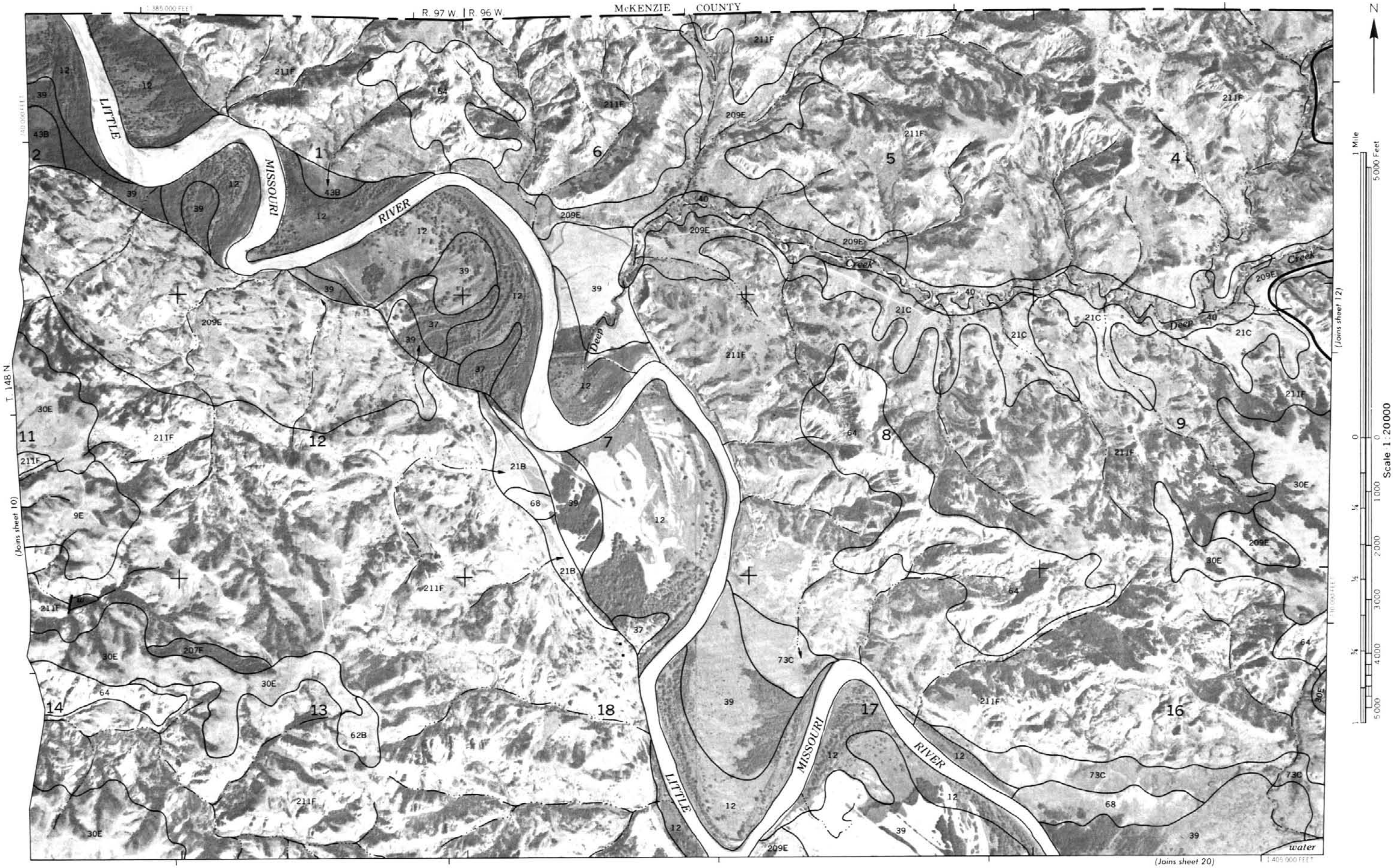
Scale 1:20000

DUNN COUNTY, NORTH DAKOTA NO. 9

This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

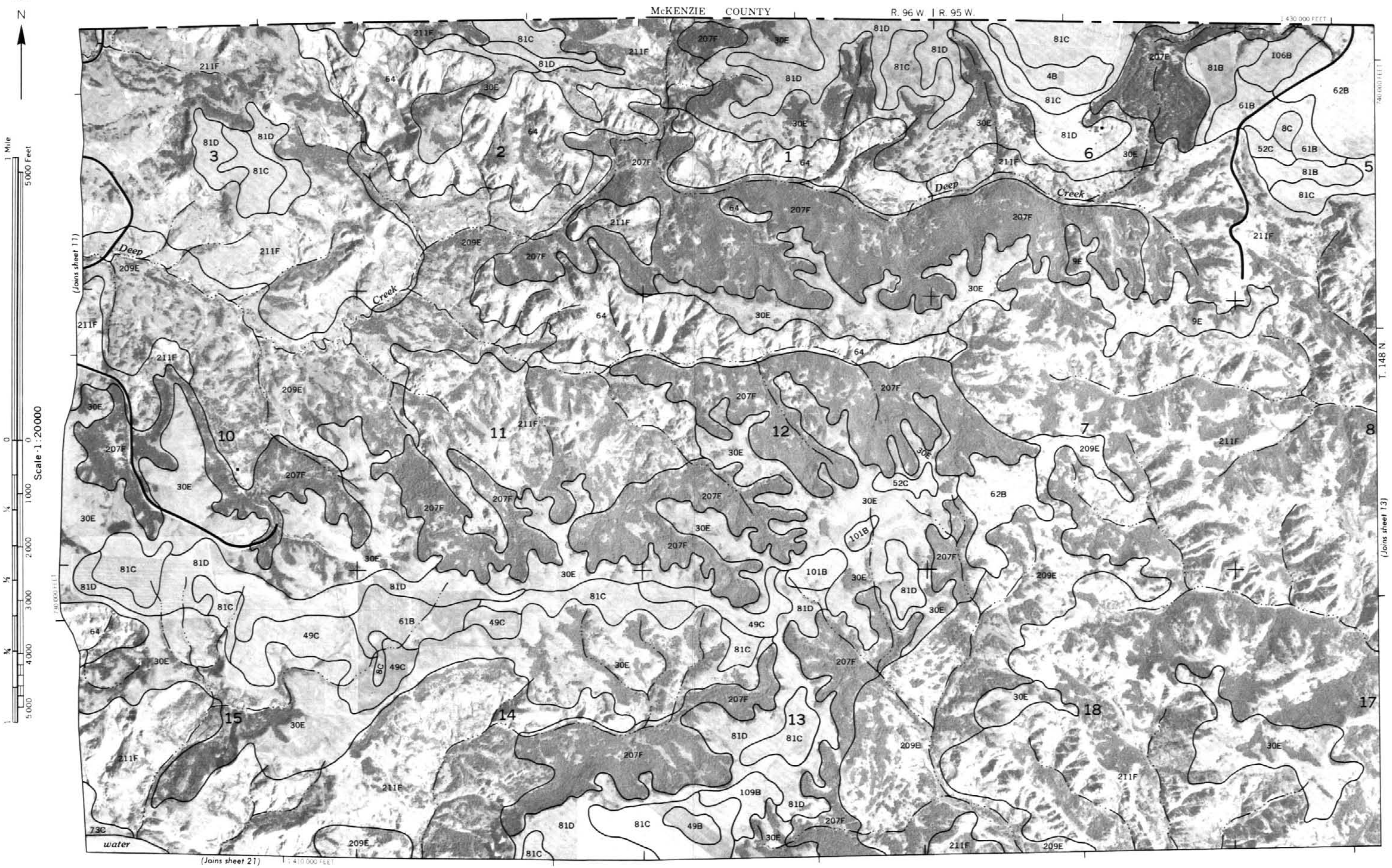
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DUNN COUNTY, NORTH DAKOTA NO. 10



DUNN COUNTY, NORTH DAKOTA NO. 11

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DUNN COUNTY, NORTH DAKOTA NO. 12

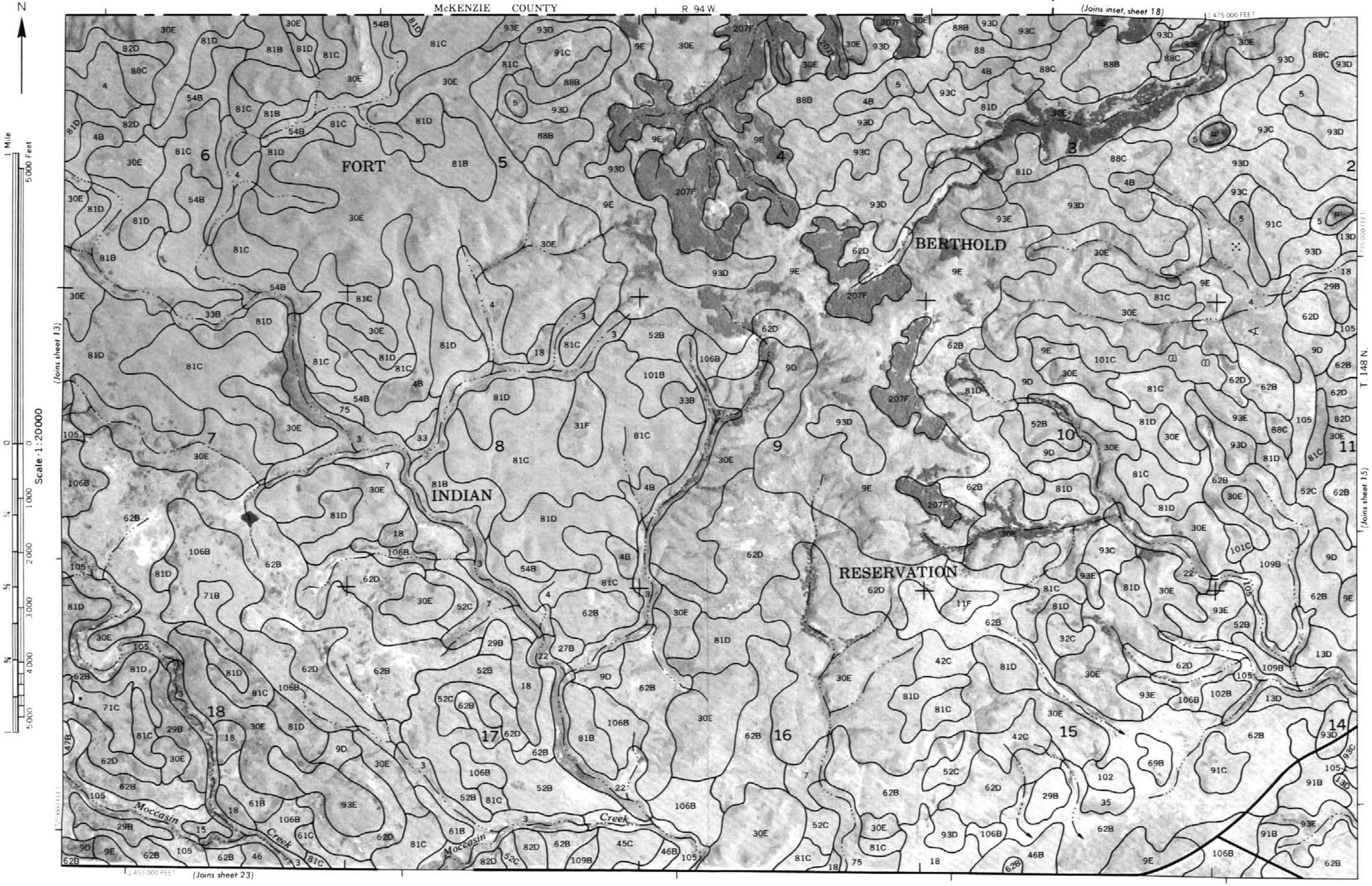
13

N

1 Mile
5000 Feet
Scale 1:20 000
0 1000 2000 3000 4000 5000
0 ¼ ½ ¾ 1

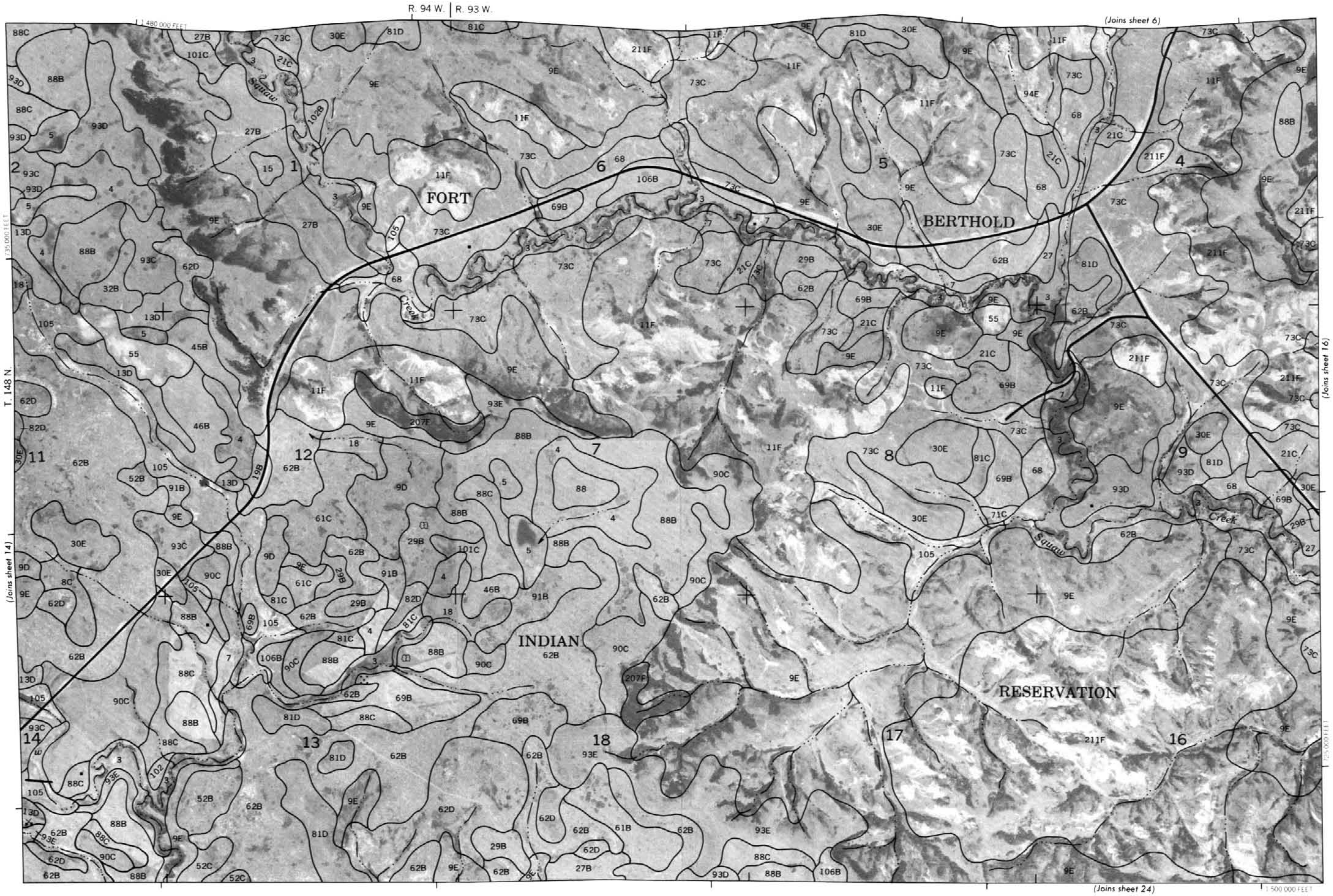
DUNN COUNTY, NORTH DAKOTA NO. 13

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DUNN COUNTY, NORTH DAKOTA NO. 14



N

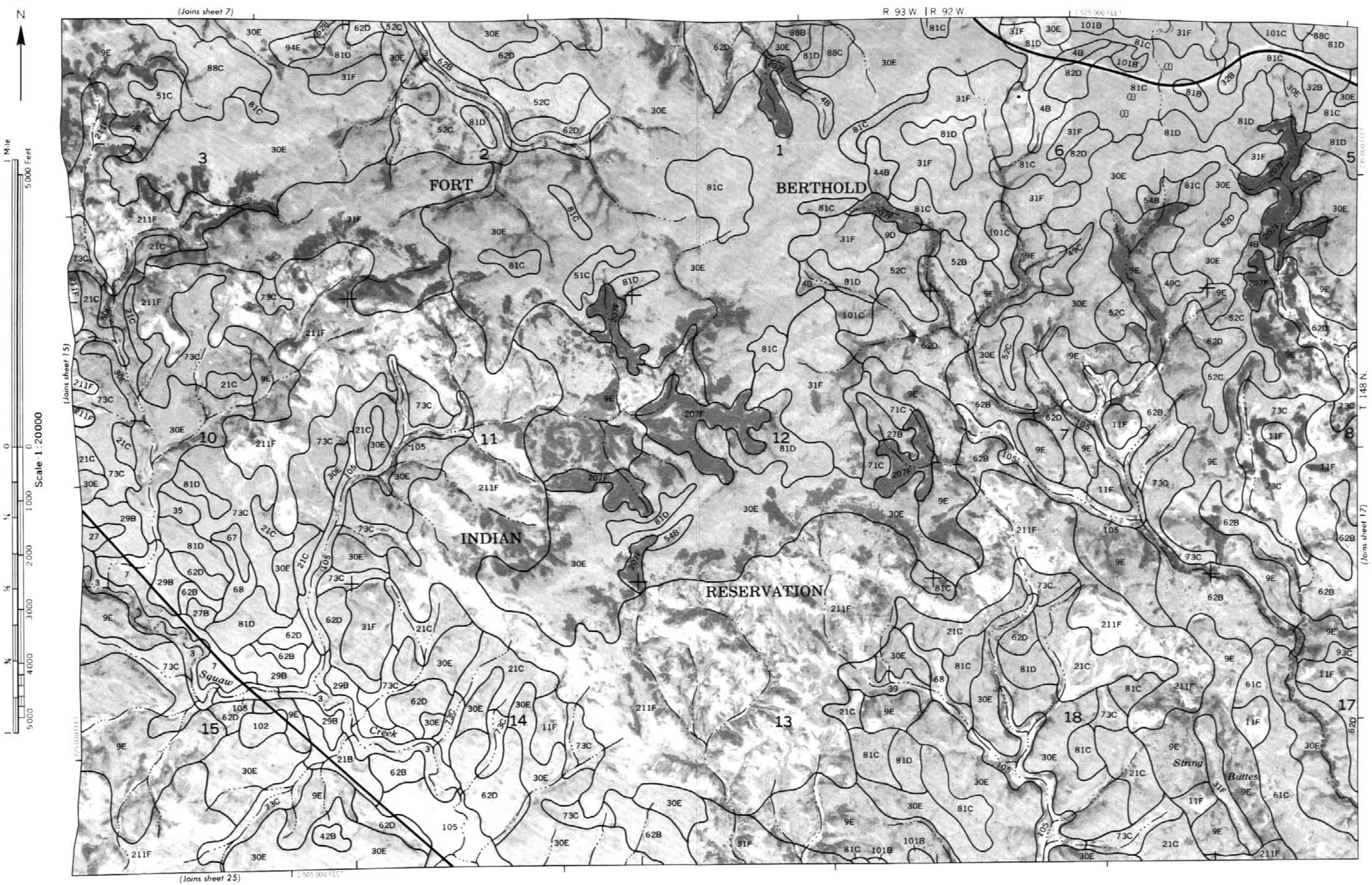
Scale 1:20000

1 Mile

5000 Feet

DUNN COUNTY, NORTH DAKOTA NO. 15

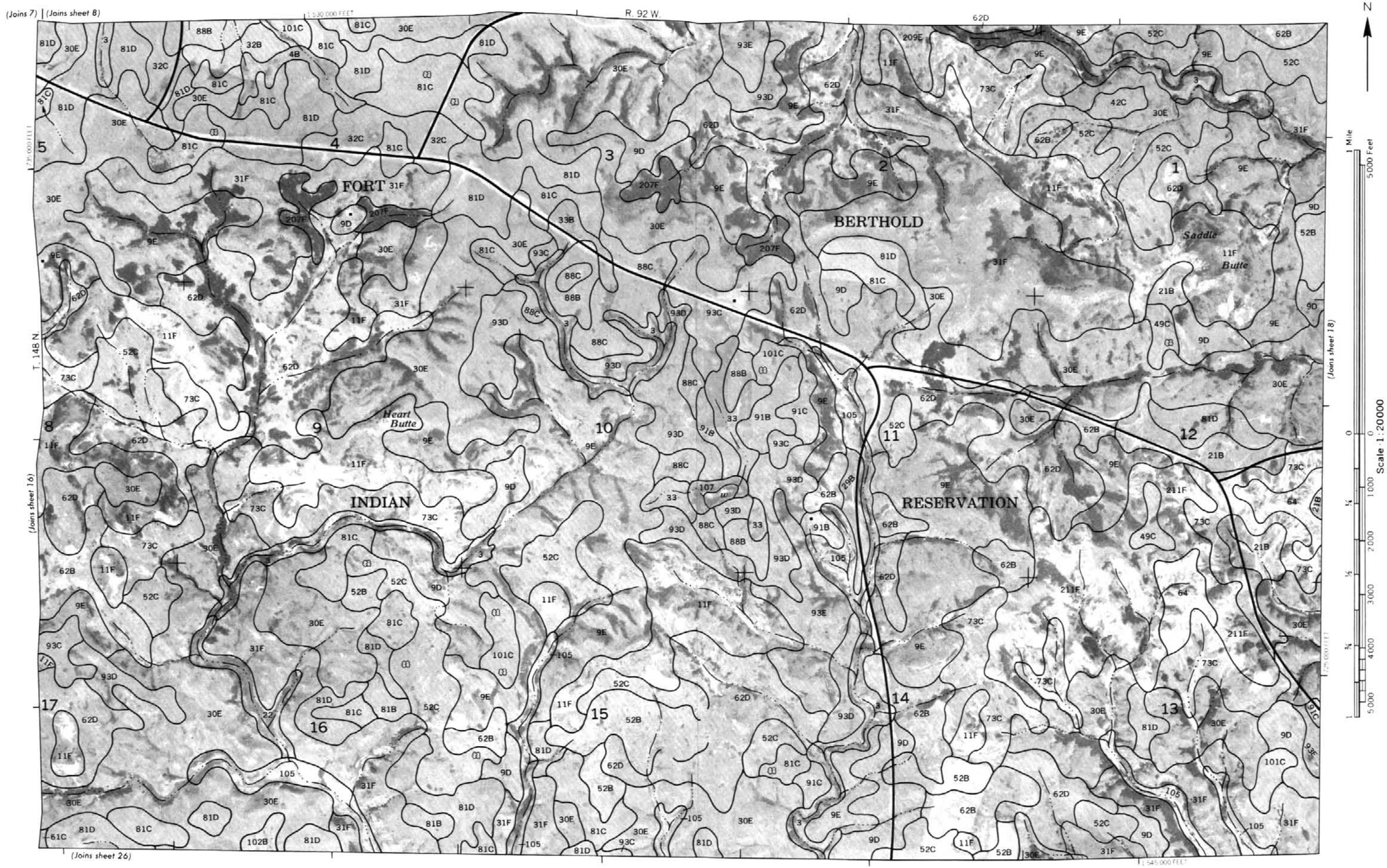
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



DUNN COUNTY, NORTH DAKOTA NO. 16

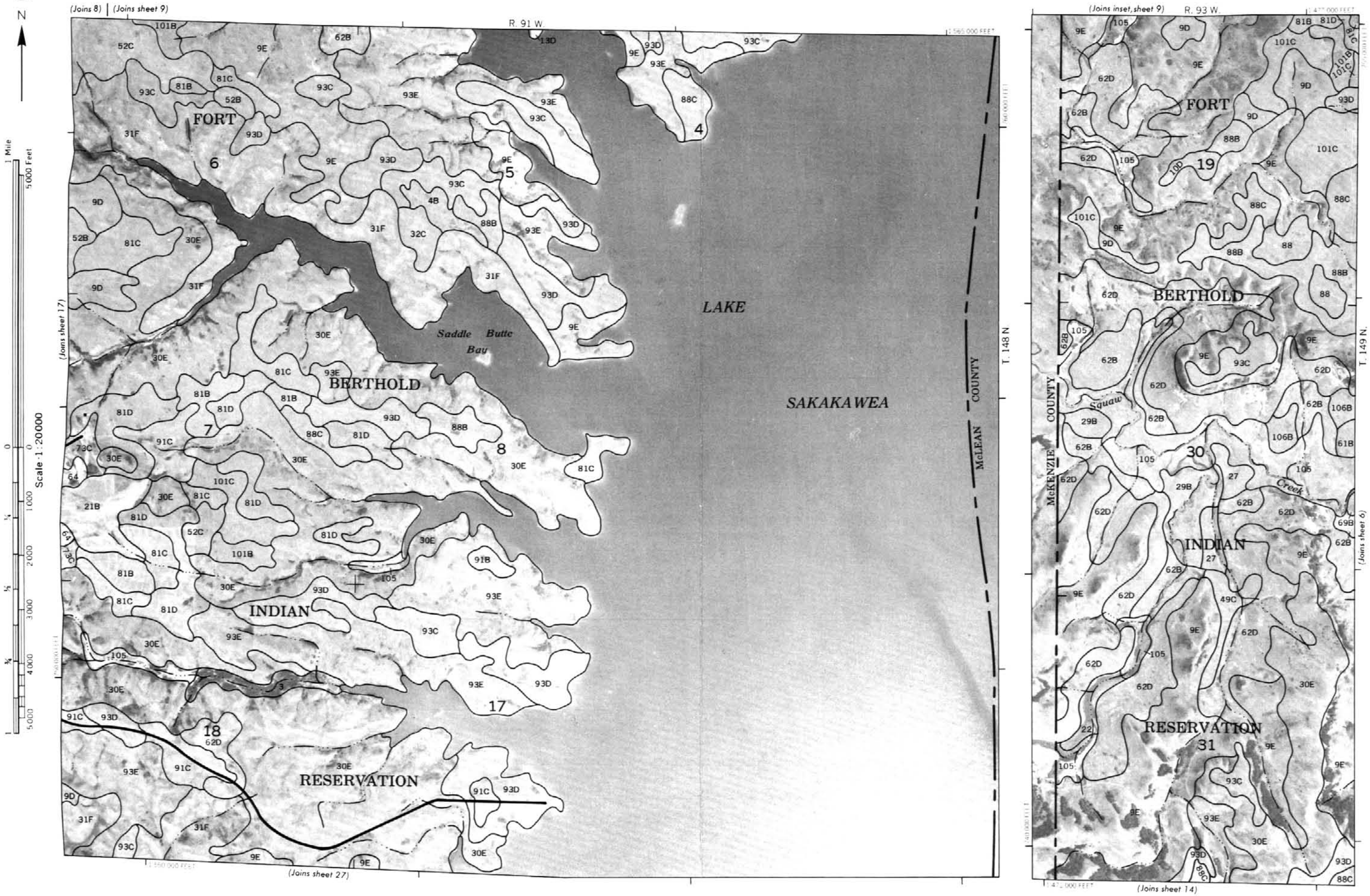
17

N



DUNN COUNTY, NORTH DAKOTA NO. 17

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DUNN COUNTY, NORTH DAKOTA NO. 18

19

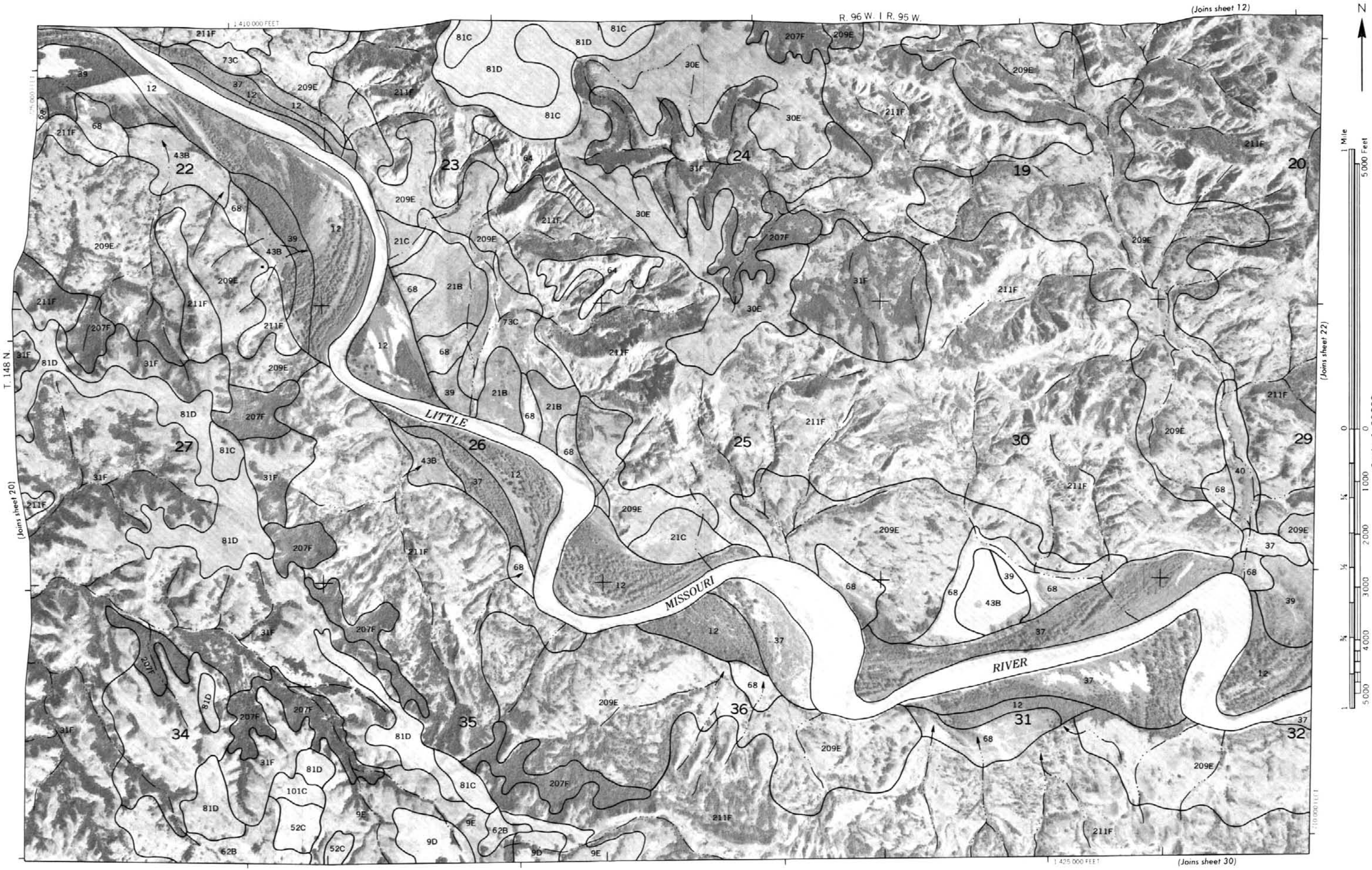
DUNN COUNTY, NORTH DAKOTA NO. 19

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

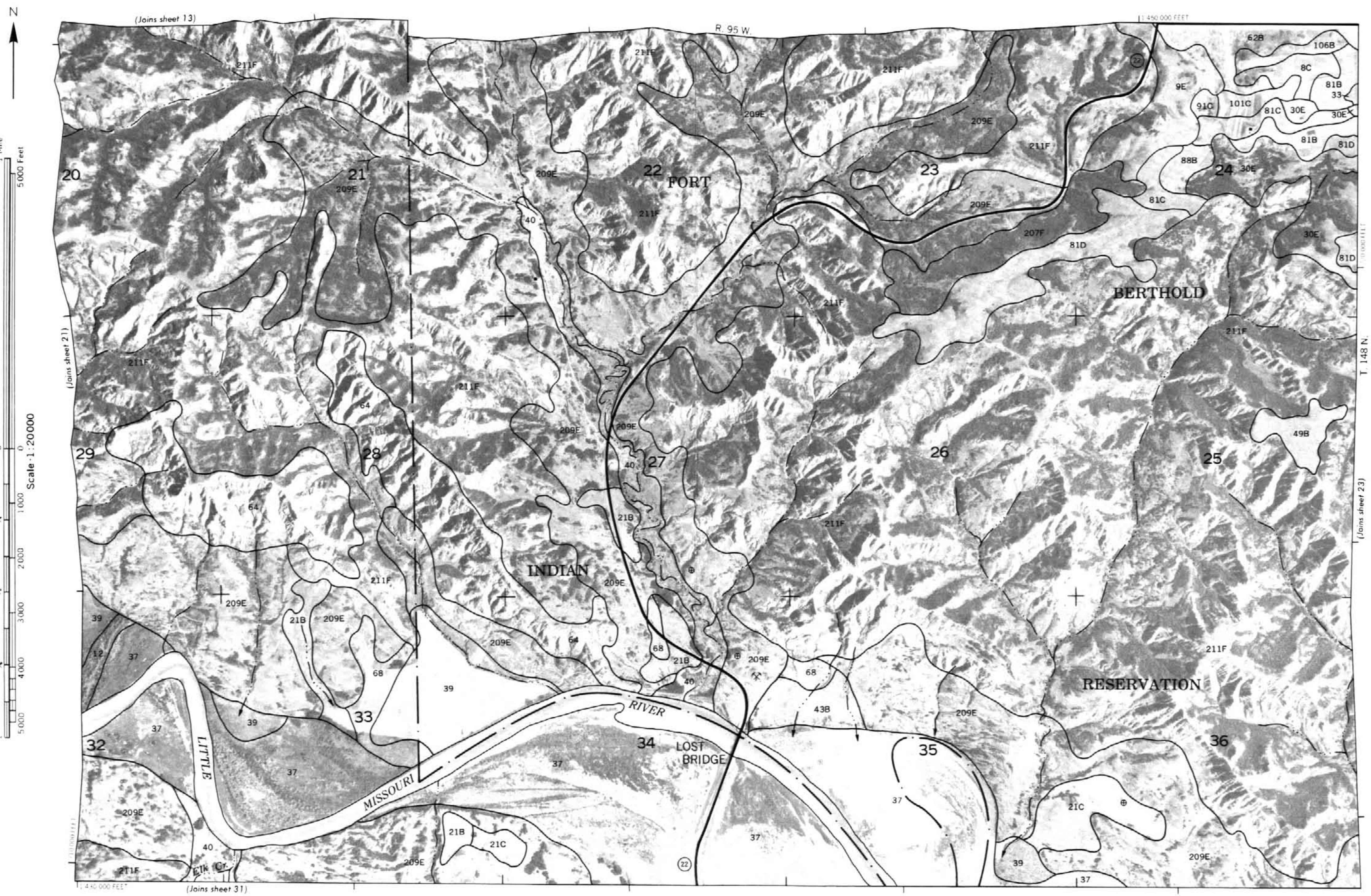
20

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DUNN COUNTY, NORTH DAKOTA NO. 20

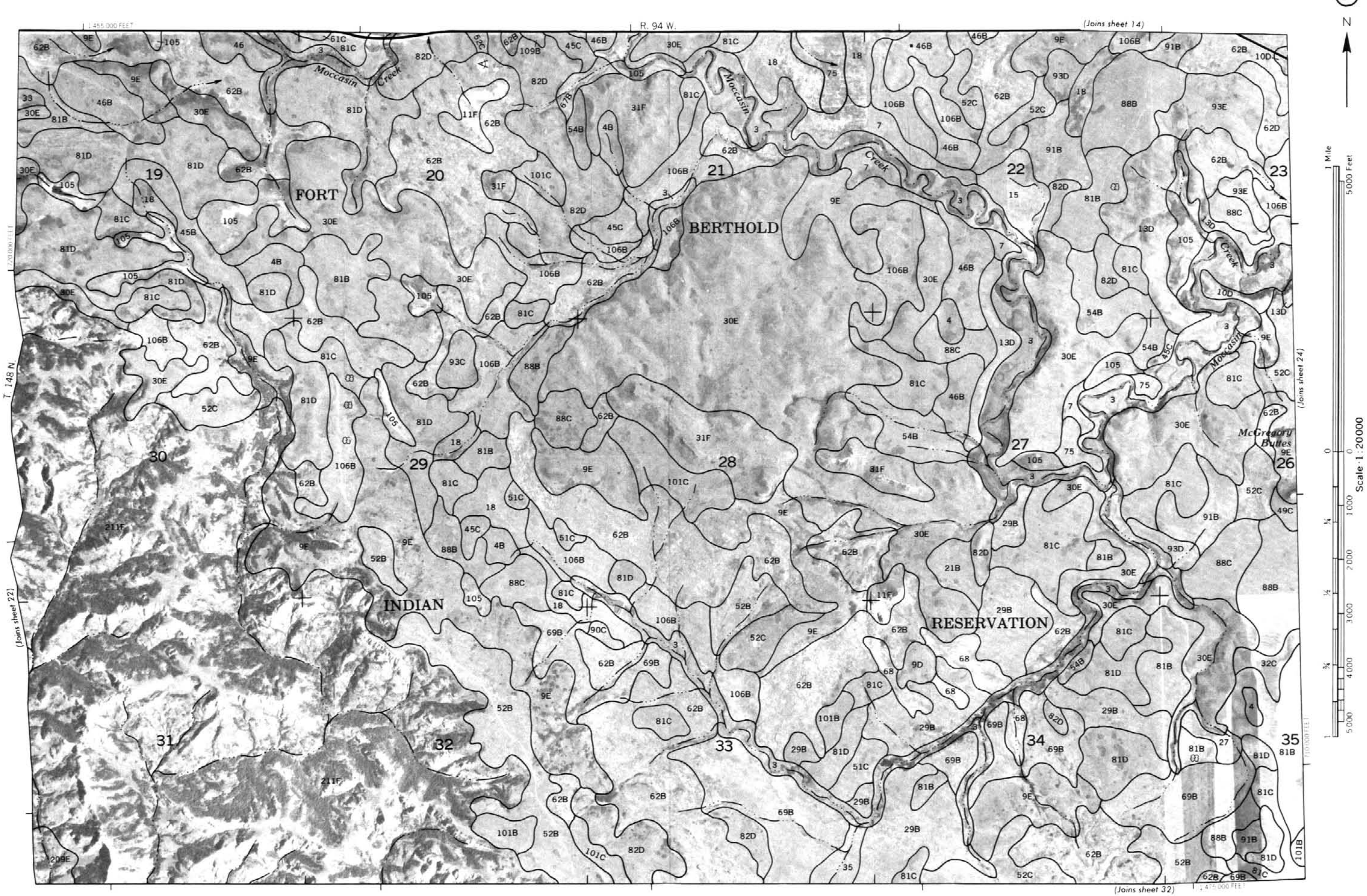


DUNN COUNTY, NORTH DAKOTA NO. 21
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



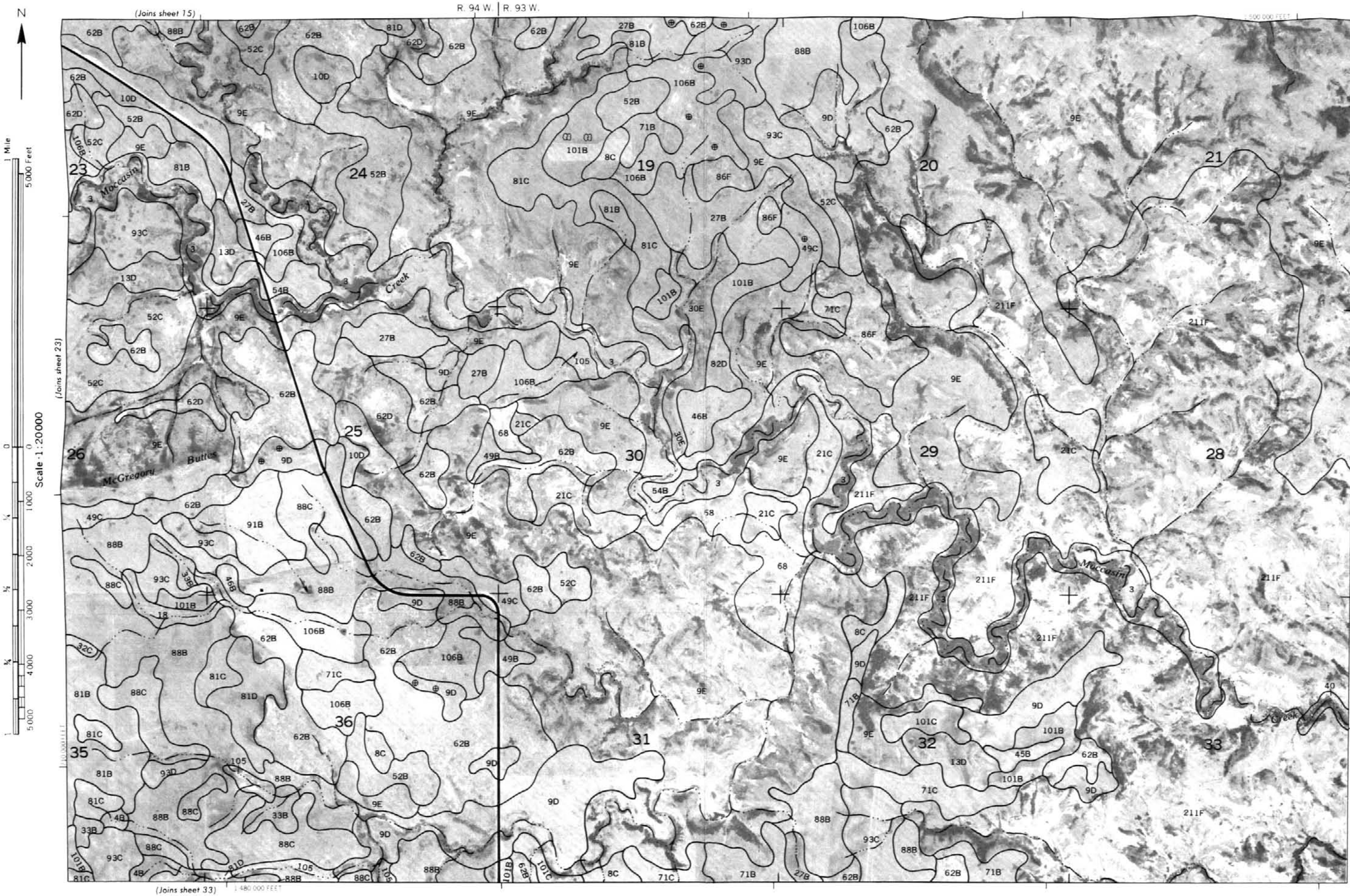
This map is compiled on 1978 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DUNN COUNTY, NORTH DAKOTA NO. 22



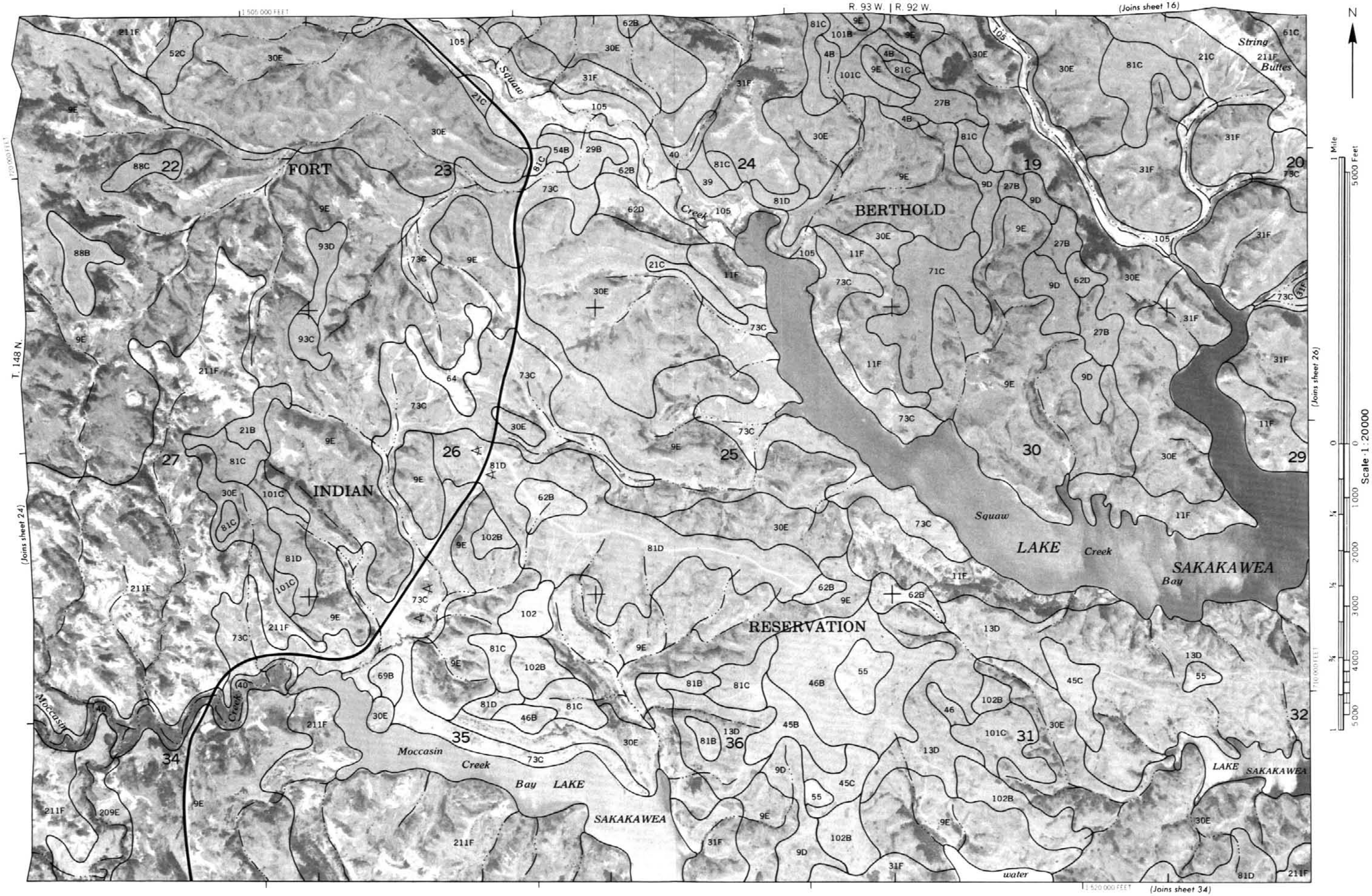
DUNN COUNTY, NORTH DAKOTA NO. 23

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

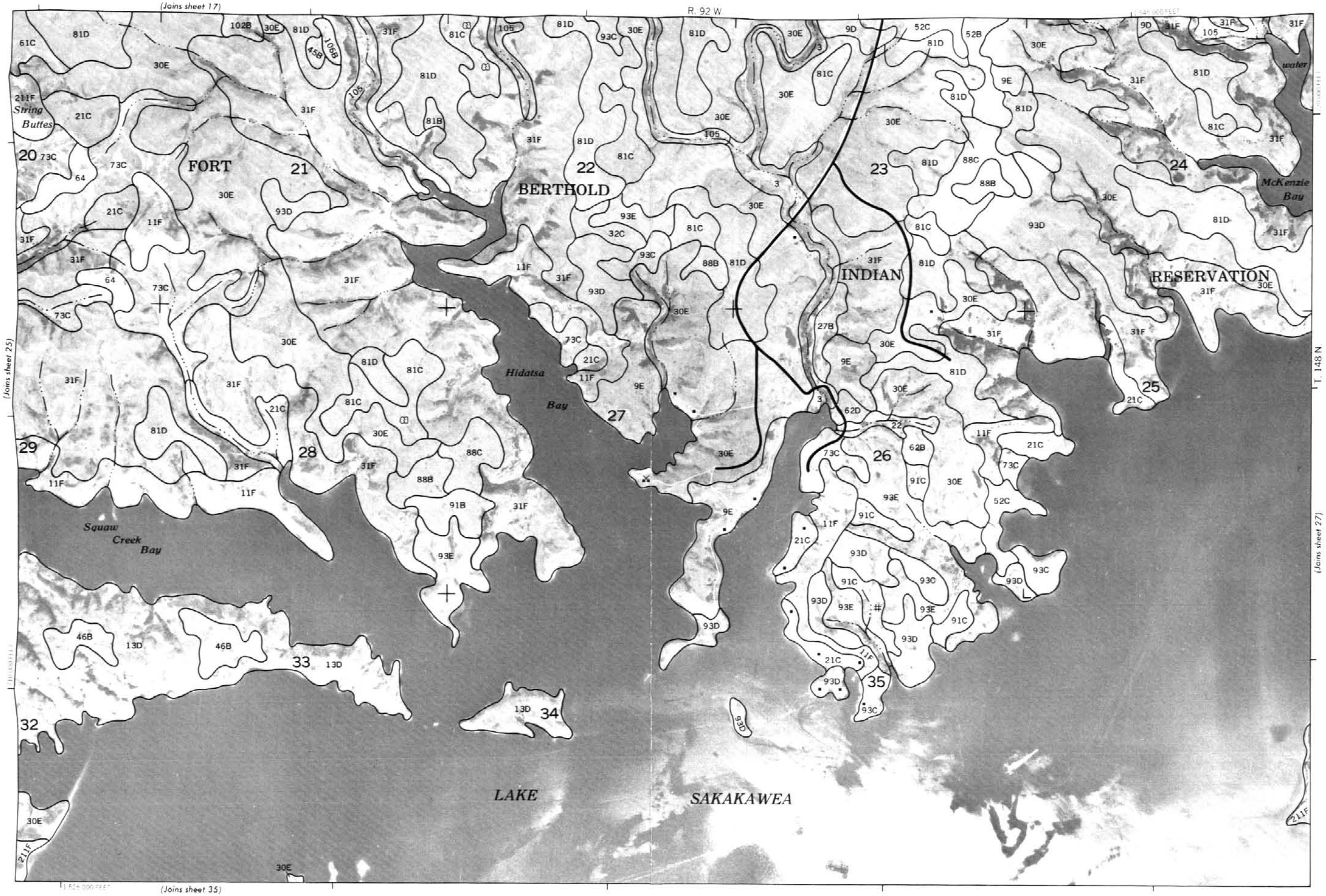

24
N
(Joins sheet 15)
R. 94 W.
R. 93 W.
T. 148 N.
(Joins sheet 23)
(Joins sheet 25)
(Joins sheet 33)
1 Mile
5000 Feet
Scale 1:20000
1 480 000 FEET
Moccasin
Creek
McGregory
Buttes
19
20
21
23
24
25
26
28
29
30
31
32
33
35
36

DUNN COUNTY, NORTH DAKOTA NO. 25

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



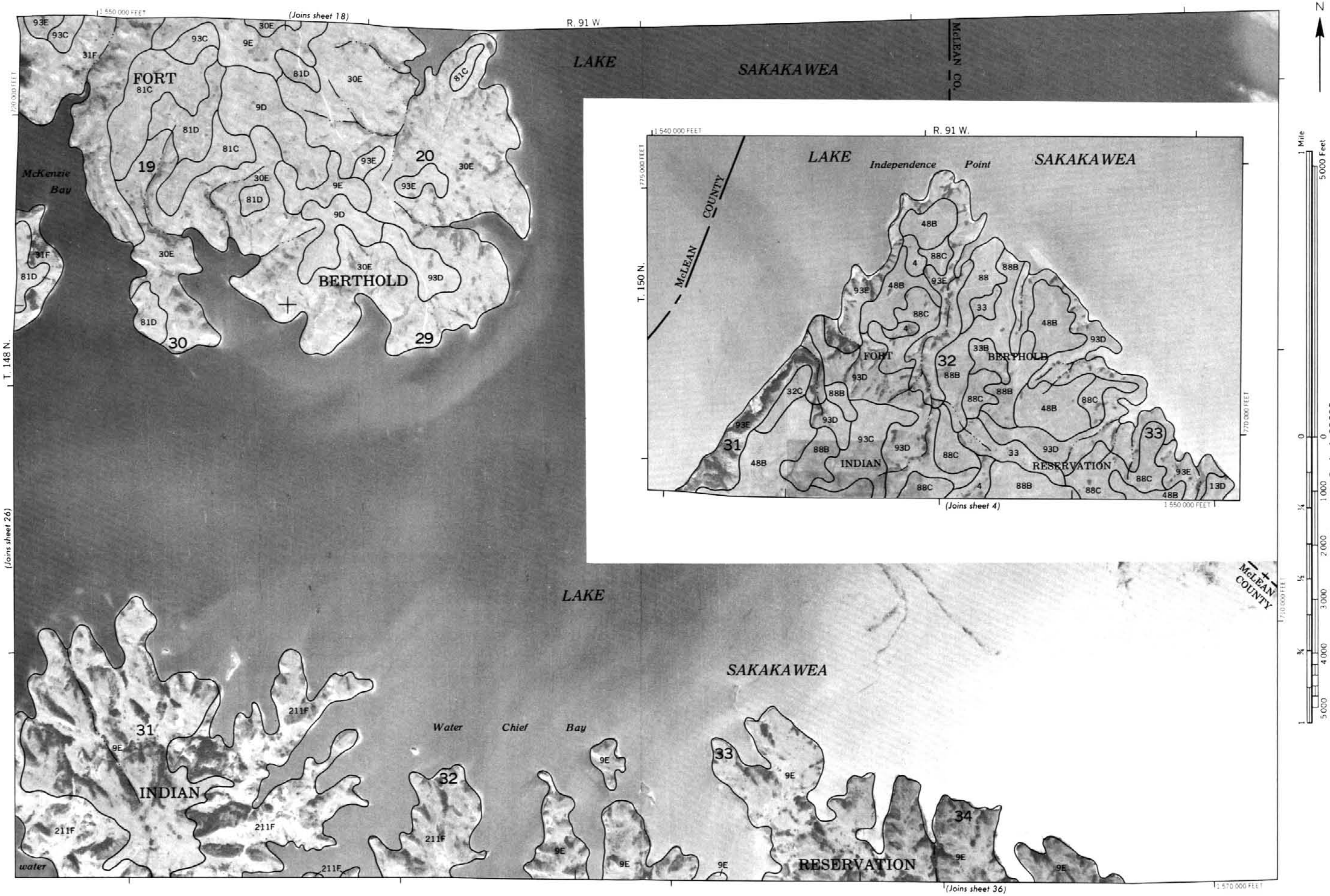
N

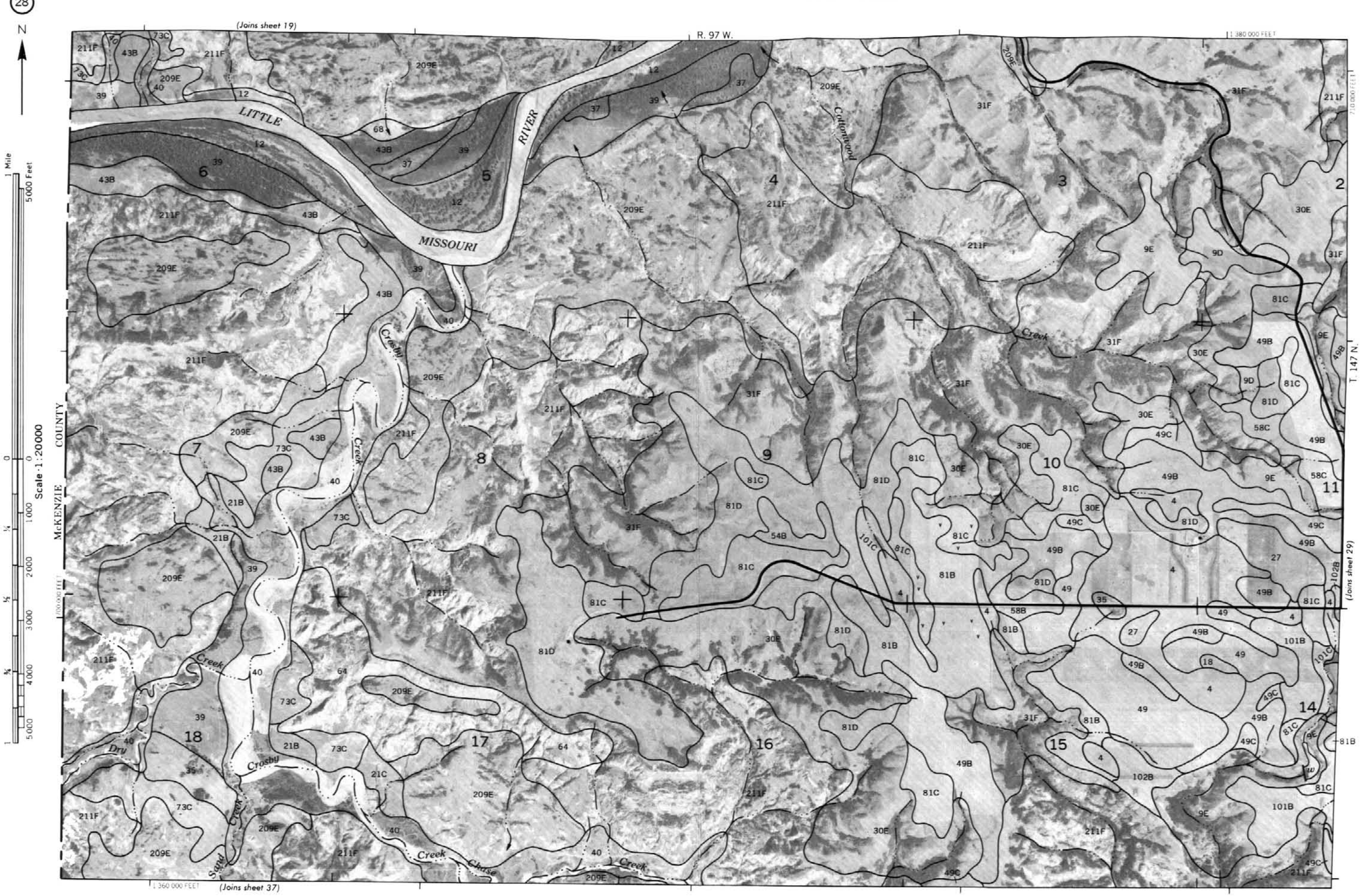


1 Mile
5000 Feet
Scale 1:20000

DUNN COUNTY, NORTH DAKOTA NO. 27

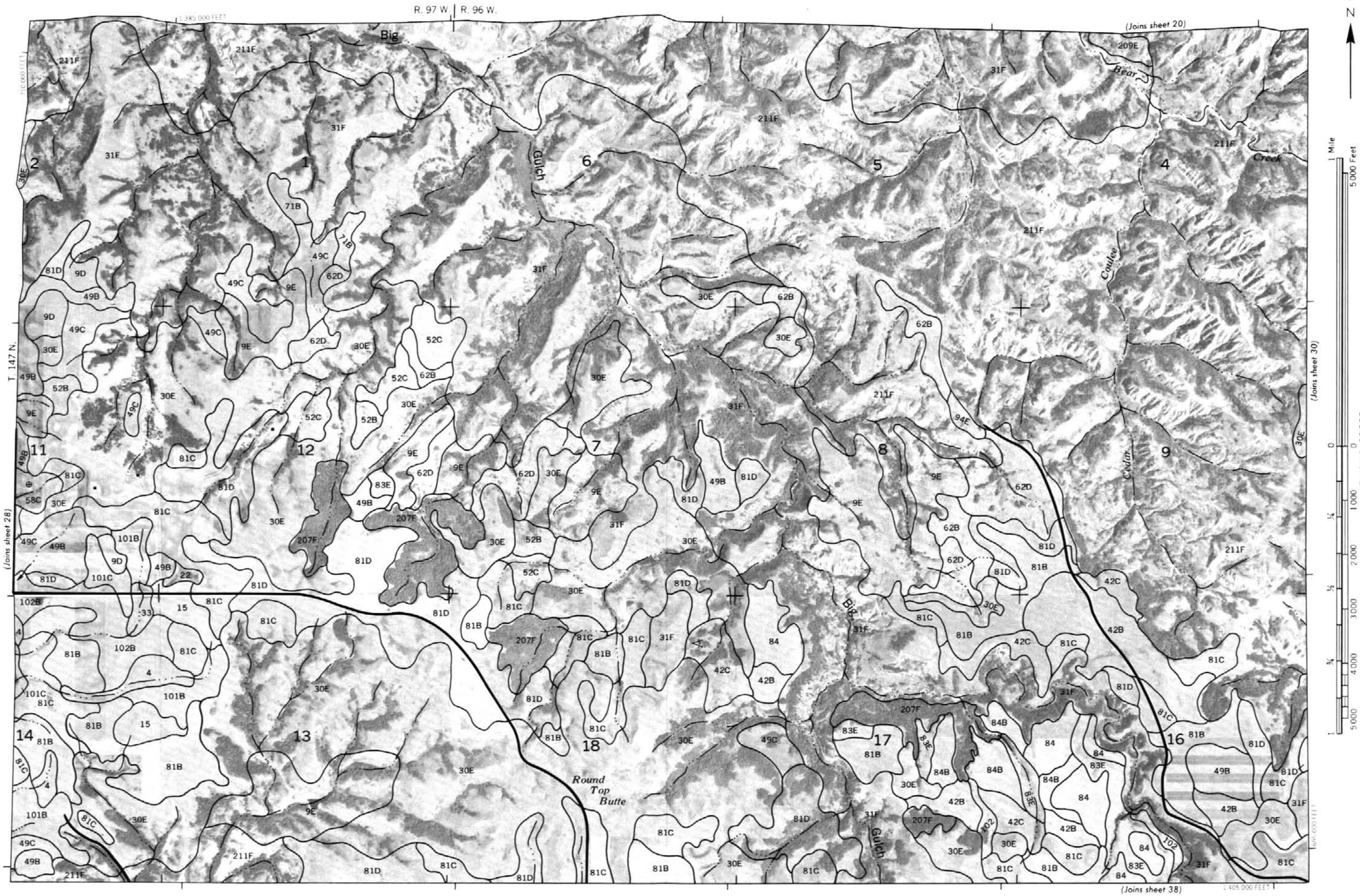
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.





This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

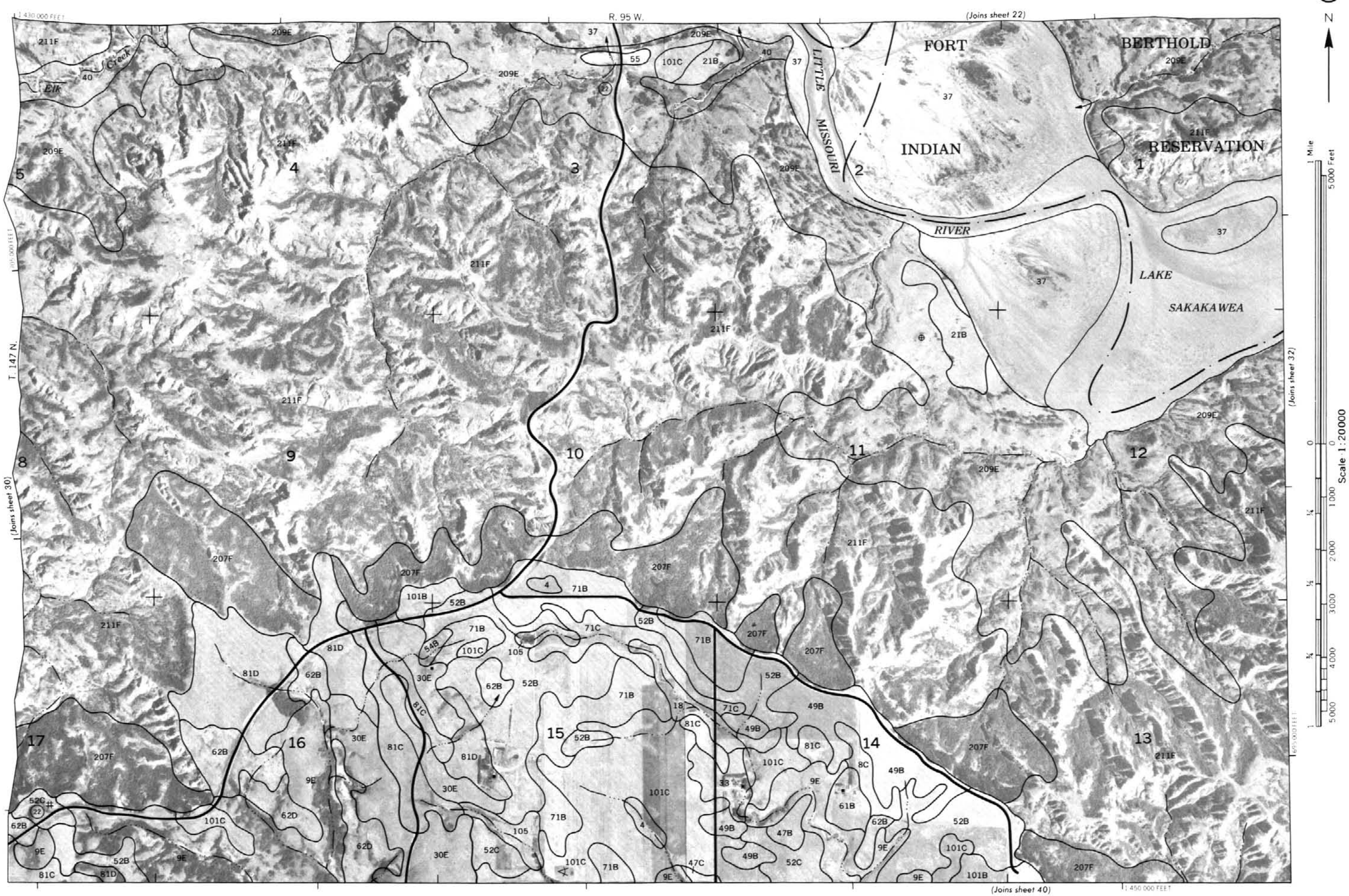
DUNN COUNTY, NORTH DAKOTA NO. 28



DUNN COUNTY, NORTH DAKOTA NO. 29

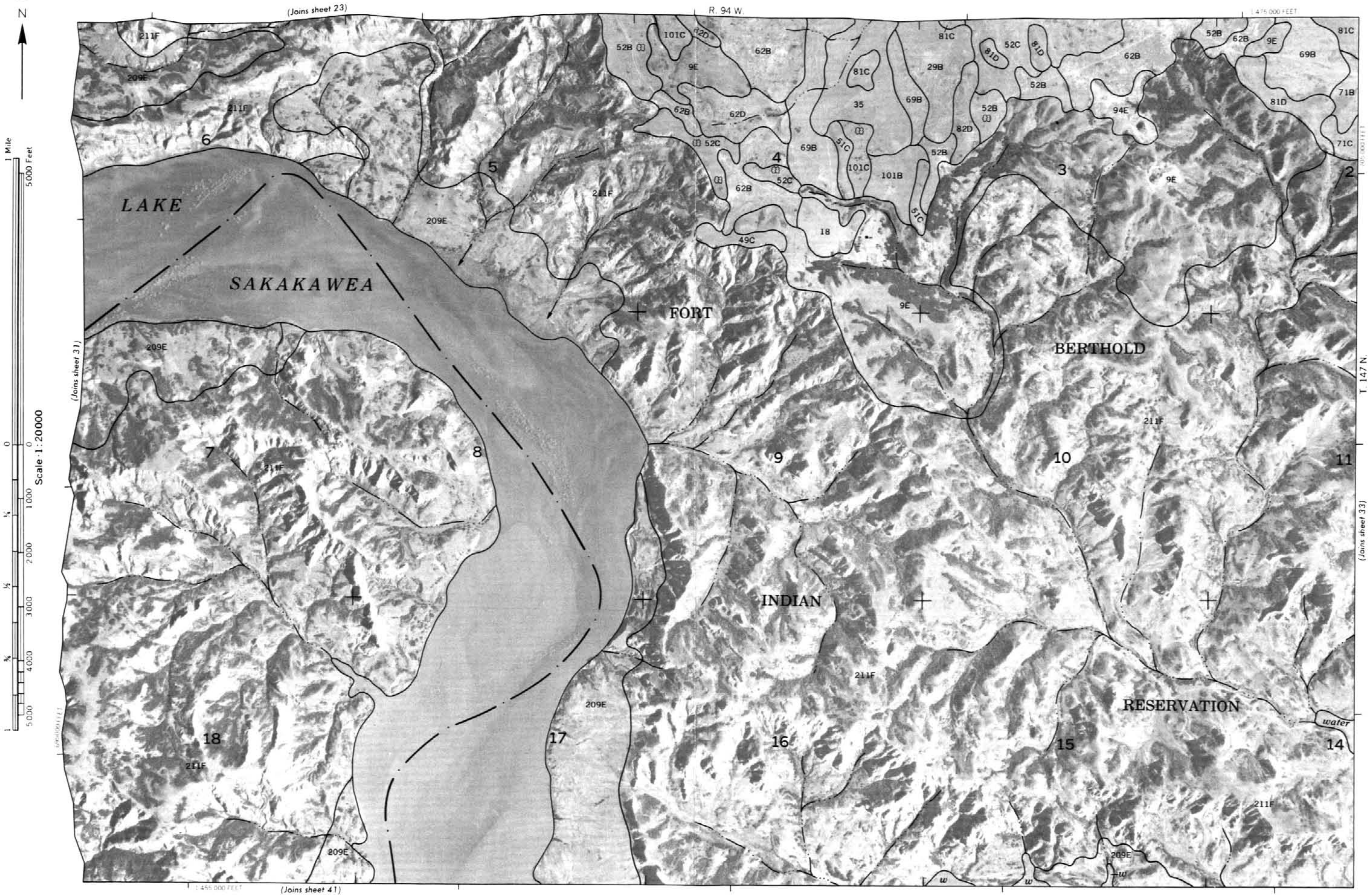
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DUNN COUNTY, NORTH DAKOTA NO. 30



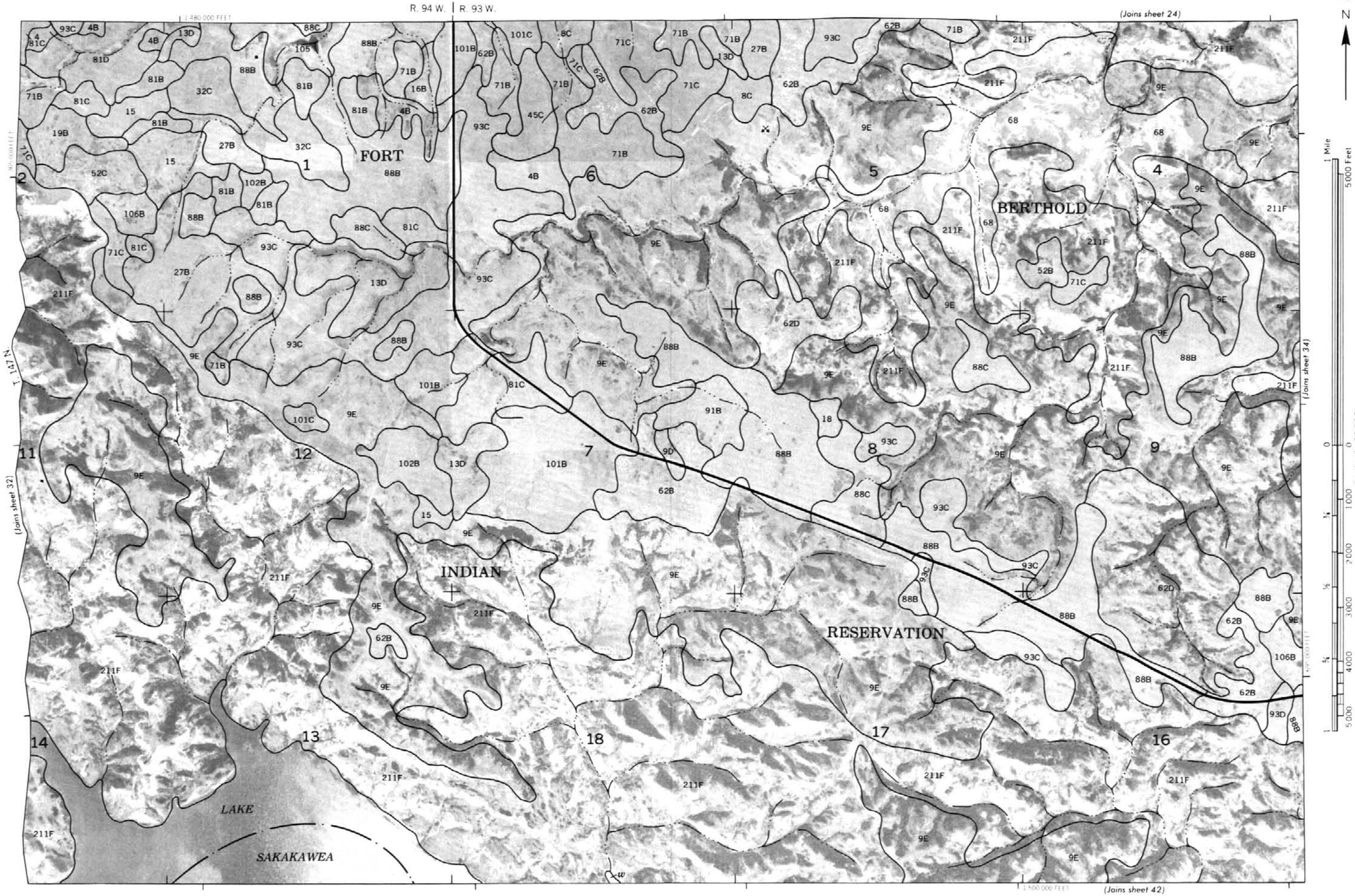
DUNN COUNTY, NORTH DAKOTA NO. 31

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

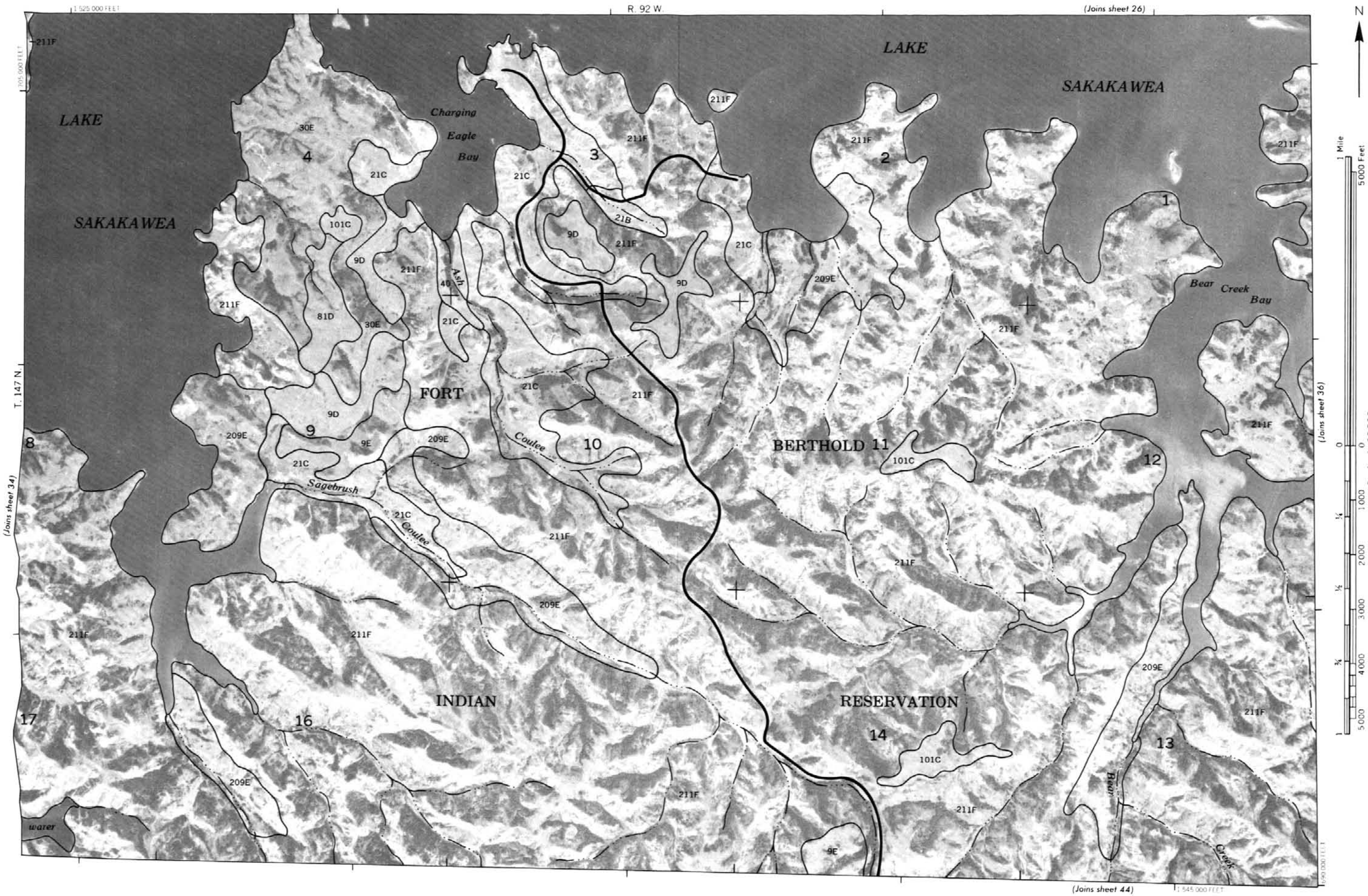
DUNN COUNTY, NORTH DAKOTA NO. 32



DUNN COUNTY, NORTH DAKOTA NO. 33


N
(Joins sheet 25)
R. 93 W. | R. 92 W.
1 520 000 FEET
T. 147 N.
(Joins sheet 33)
(Joins sheet 35)
(Joins sheet 43)
1 505 000 FEET
Scale 1:20000
1 Mile
5 000 Feet
FORT
BERTHOLD
INDIAN
RESERVATION
Moccasin Creek Bay
LAKE
SAKAKAWEA
1
2
3
5
6
7
8
10
11
12
13
14
15
17
18
211F
9E
209E
31F
9D
30E
81D
88B
62B
52C
62D
88C
91B
91C
32C
101B
9D
52B
90C
49B
106B
64
93E

35

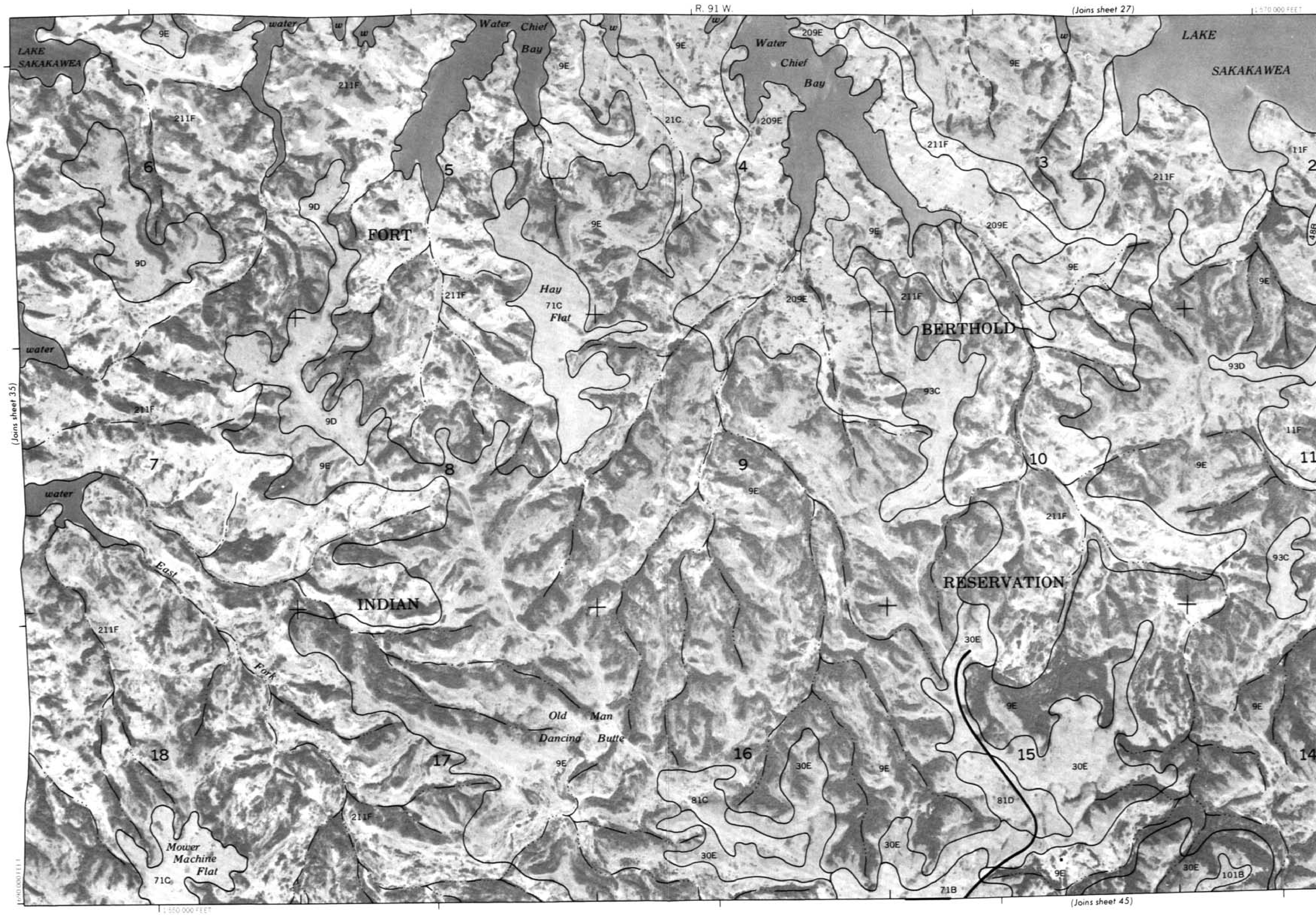


DUNN COUNTY, NORTH DAKOTA NO. 35

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

36

N



1 Mile

5000 Feet

Scale 1:20000

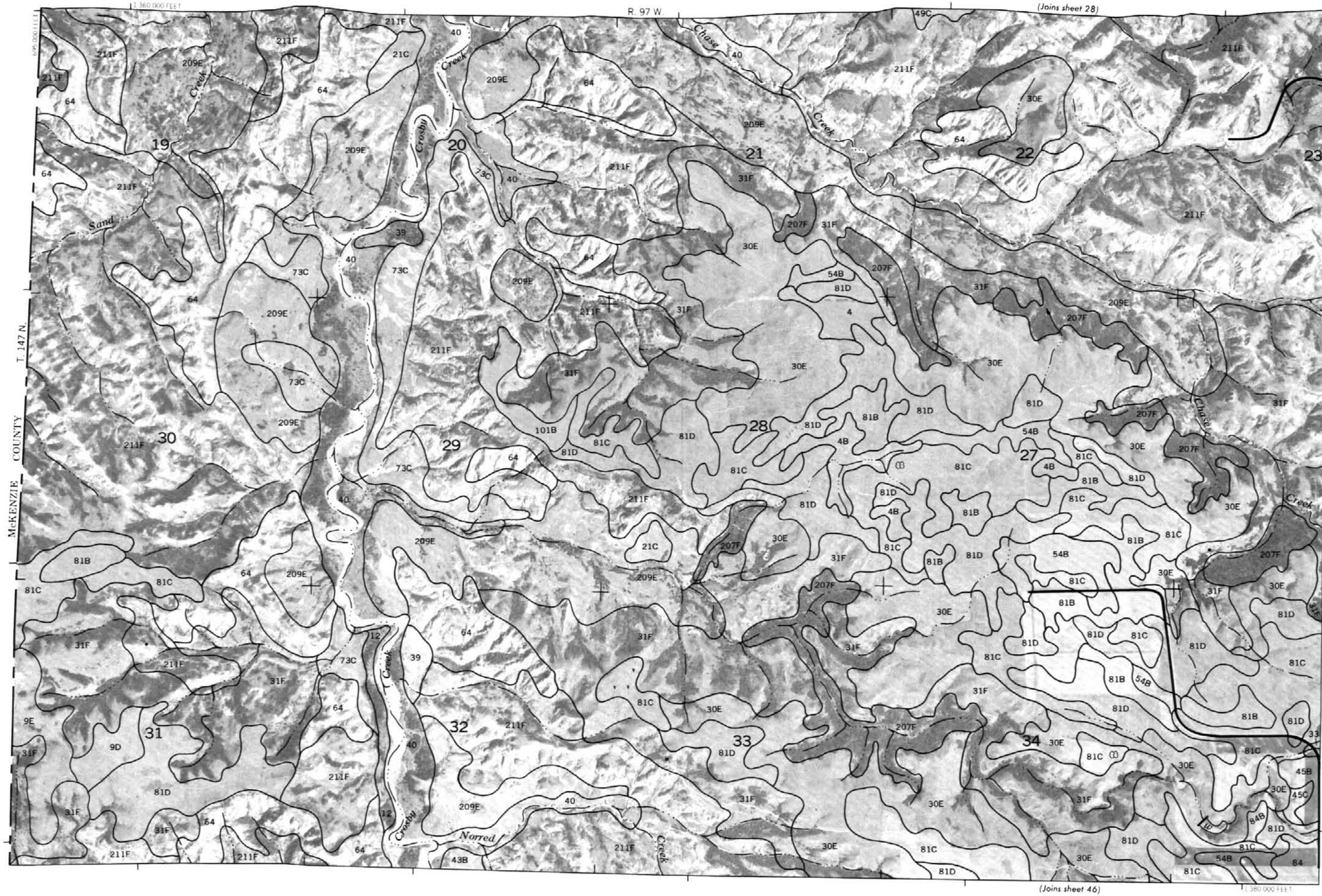
0 1000 2000 3000 4000 5000

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DUNN COUNTY, NORTH DAKOTA NO. 36

37

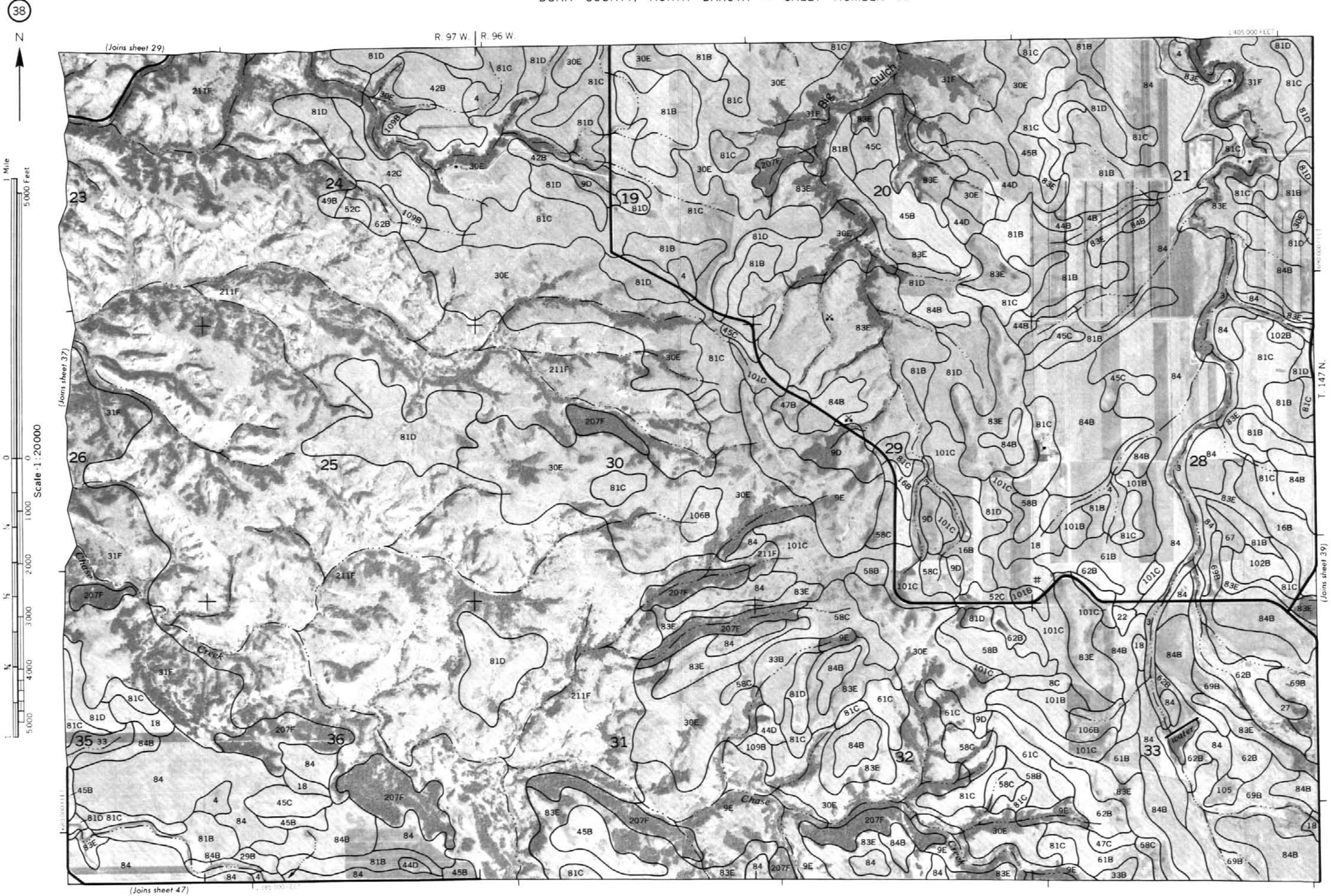
N



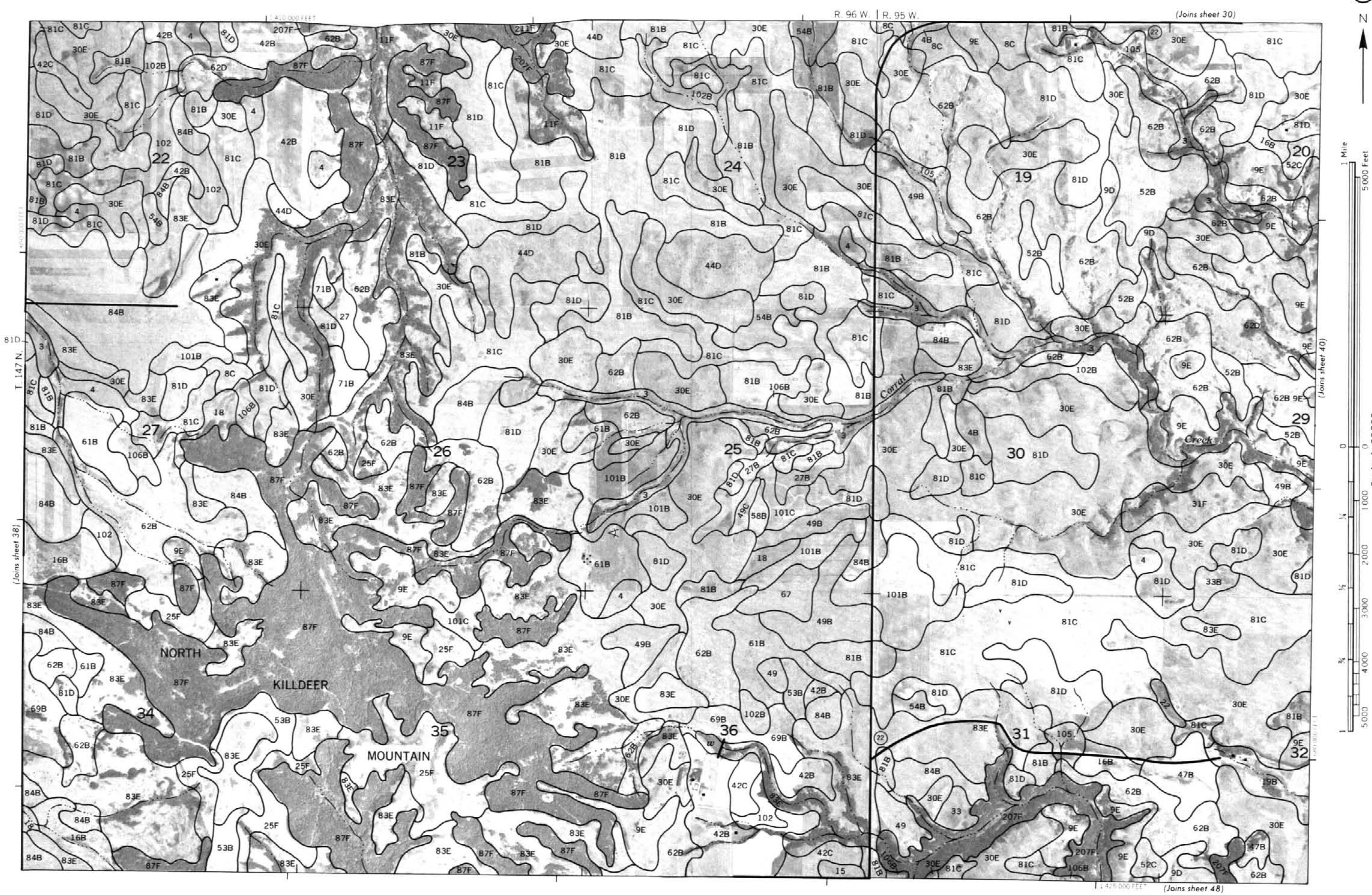
1 Mile
5000 Feet
Scale 1:20000

DUNN COUNTY, NORTH DAKOTA NO. 37

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

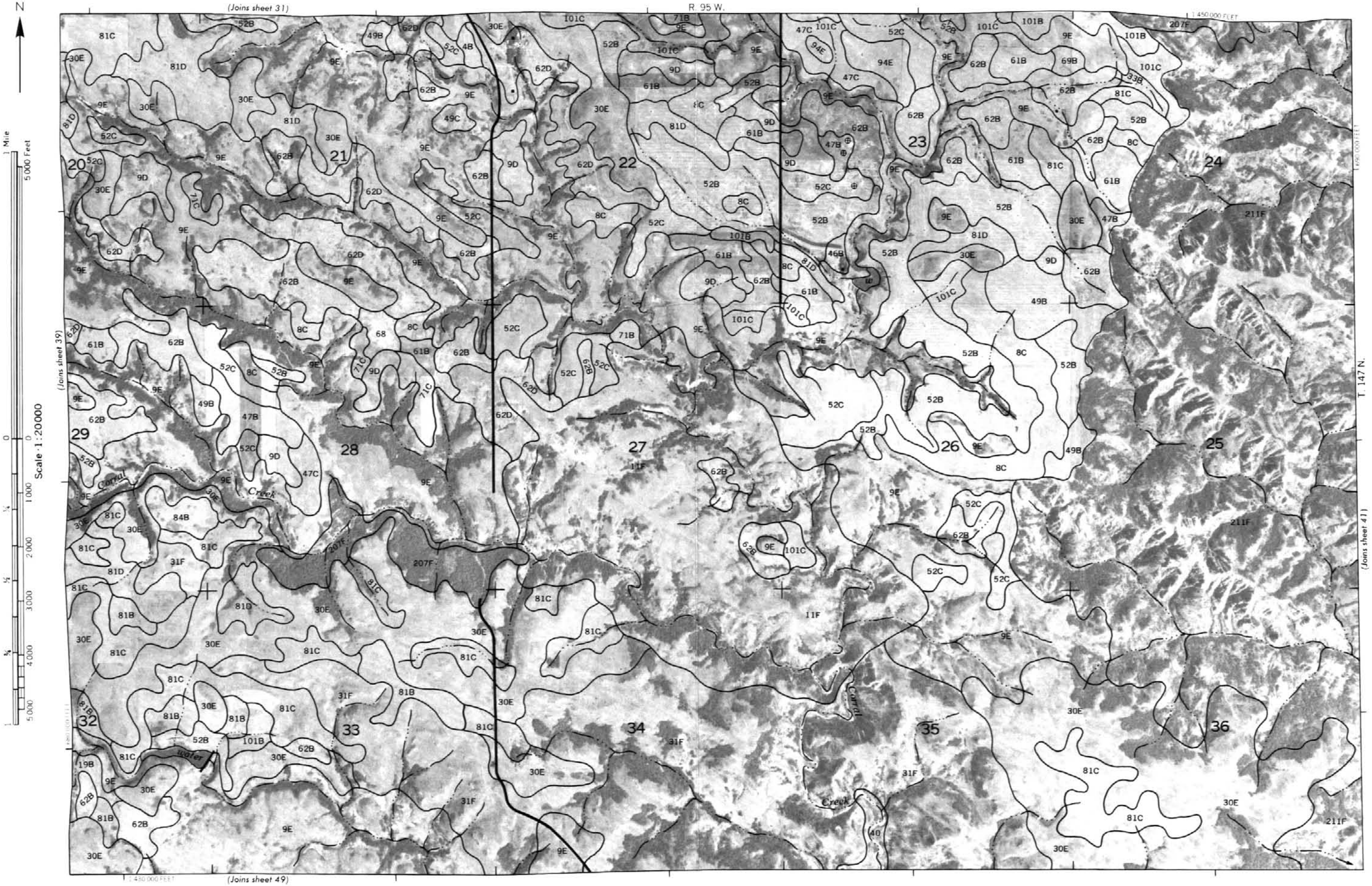


DUNN COUNTY, NORTH DAKOTA NO. 38

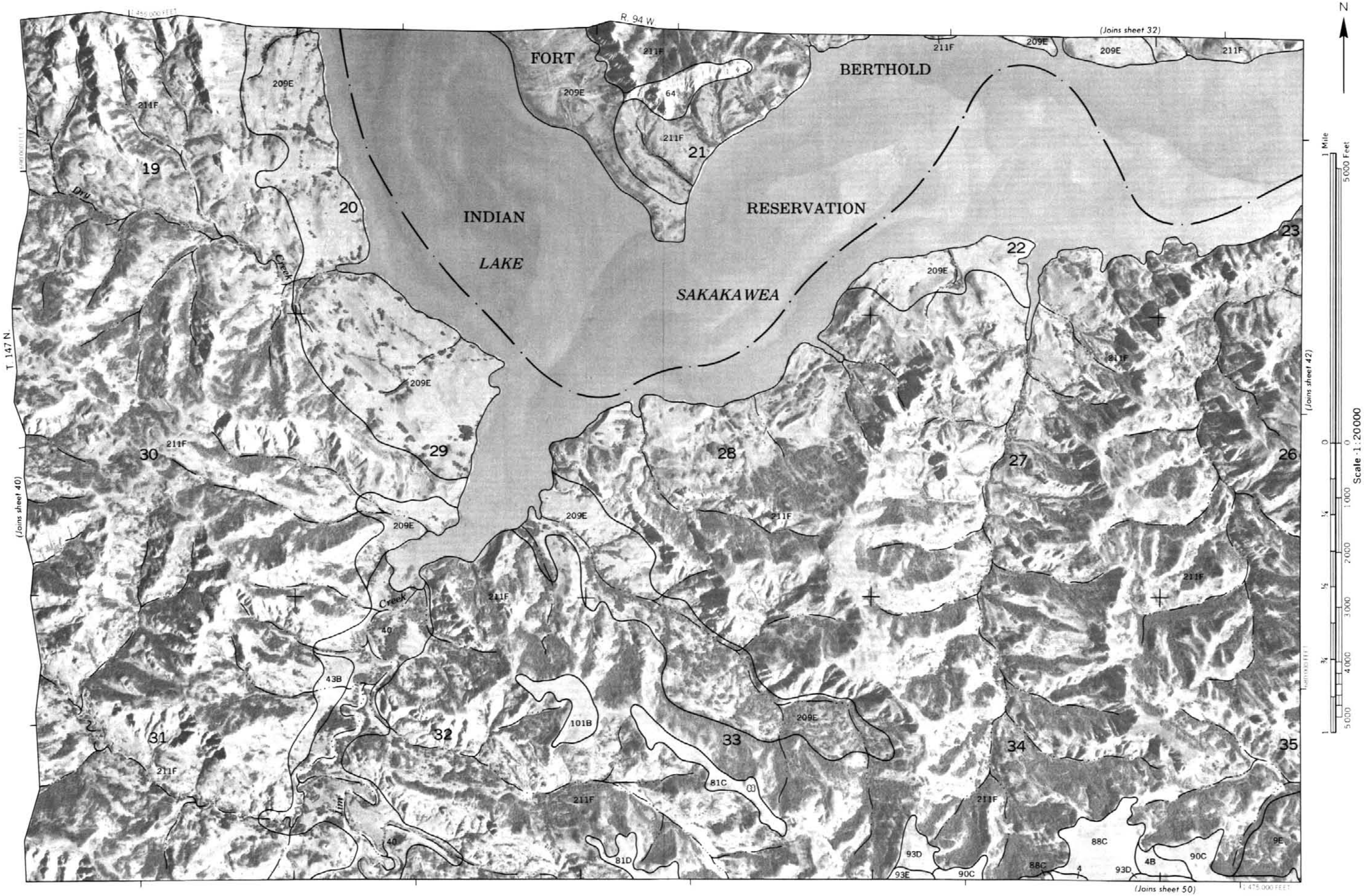


DUNN COUNTY, NORTH DAKOTA NO. 39

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.


40
N
(Joins sheet 31)
R. 95 W.
1 450 000 FEET
(Joins sheet 39)
(Joins sheet 41)
(Joins sheet 49)
T. 147 N.
1 430 000 FEET
Scale 1:20000
1 Mile
5 000 Feet
Corral Creek
water
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36

41

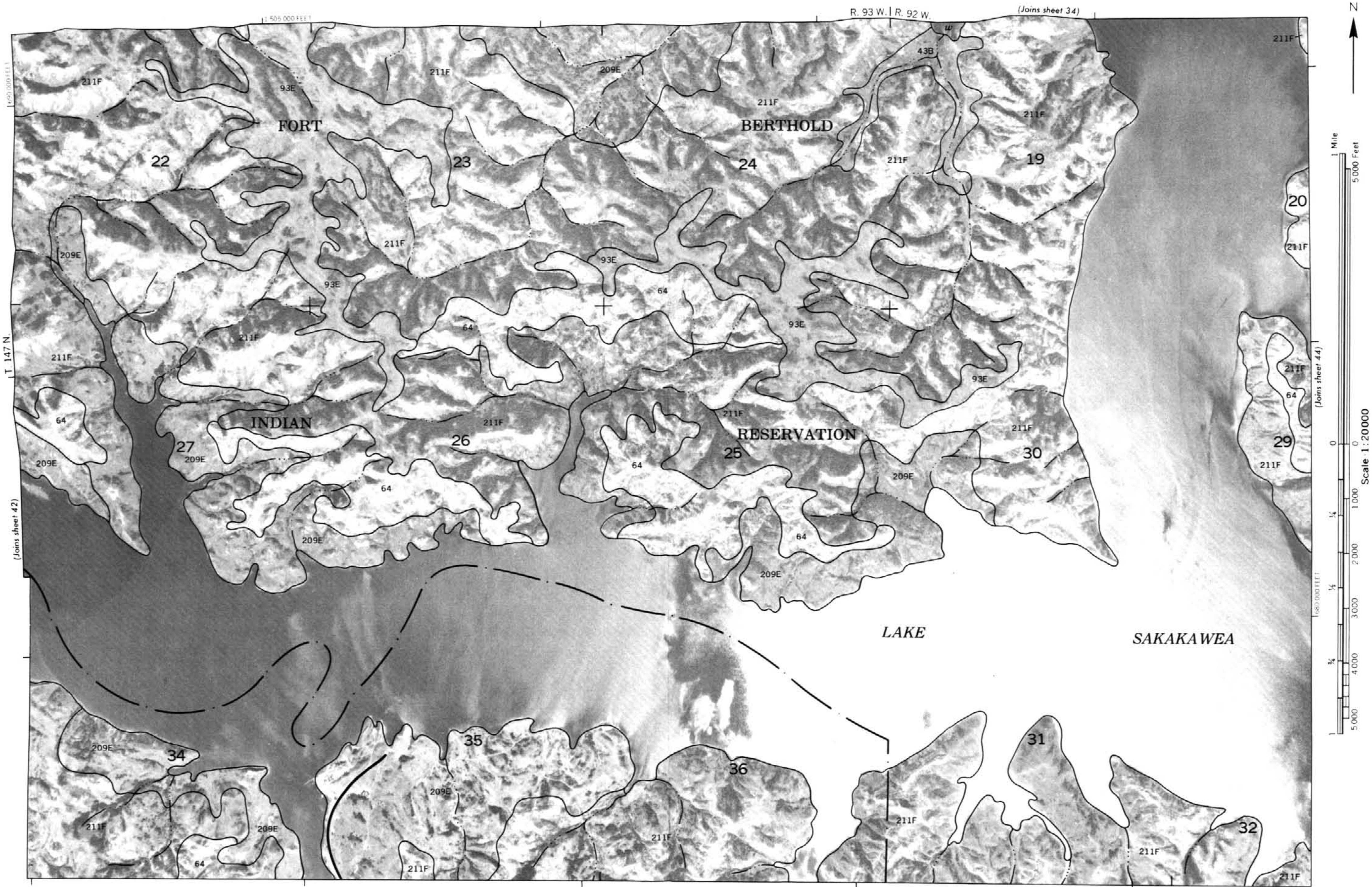


DUNN COUNTY, NORTH DAKOTA NO. 41

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

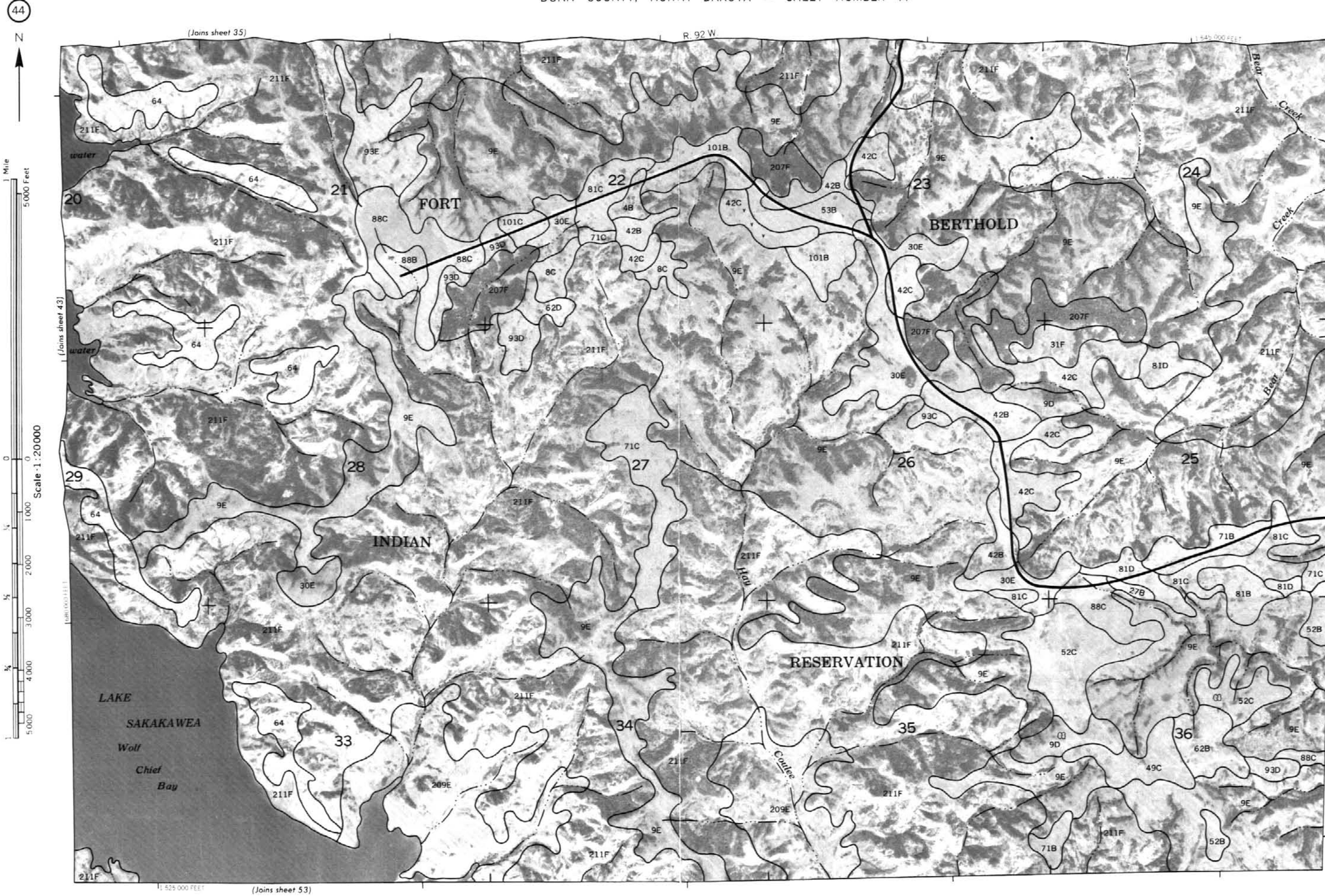
N

1 Mile
5000 Feet
Scale 1:20000
0 ¼ ½ ¾ 1
0 1000 2000 3000 4000 5000



DUNN COUNTY, NORTH DAKOTA NO. 43

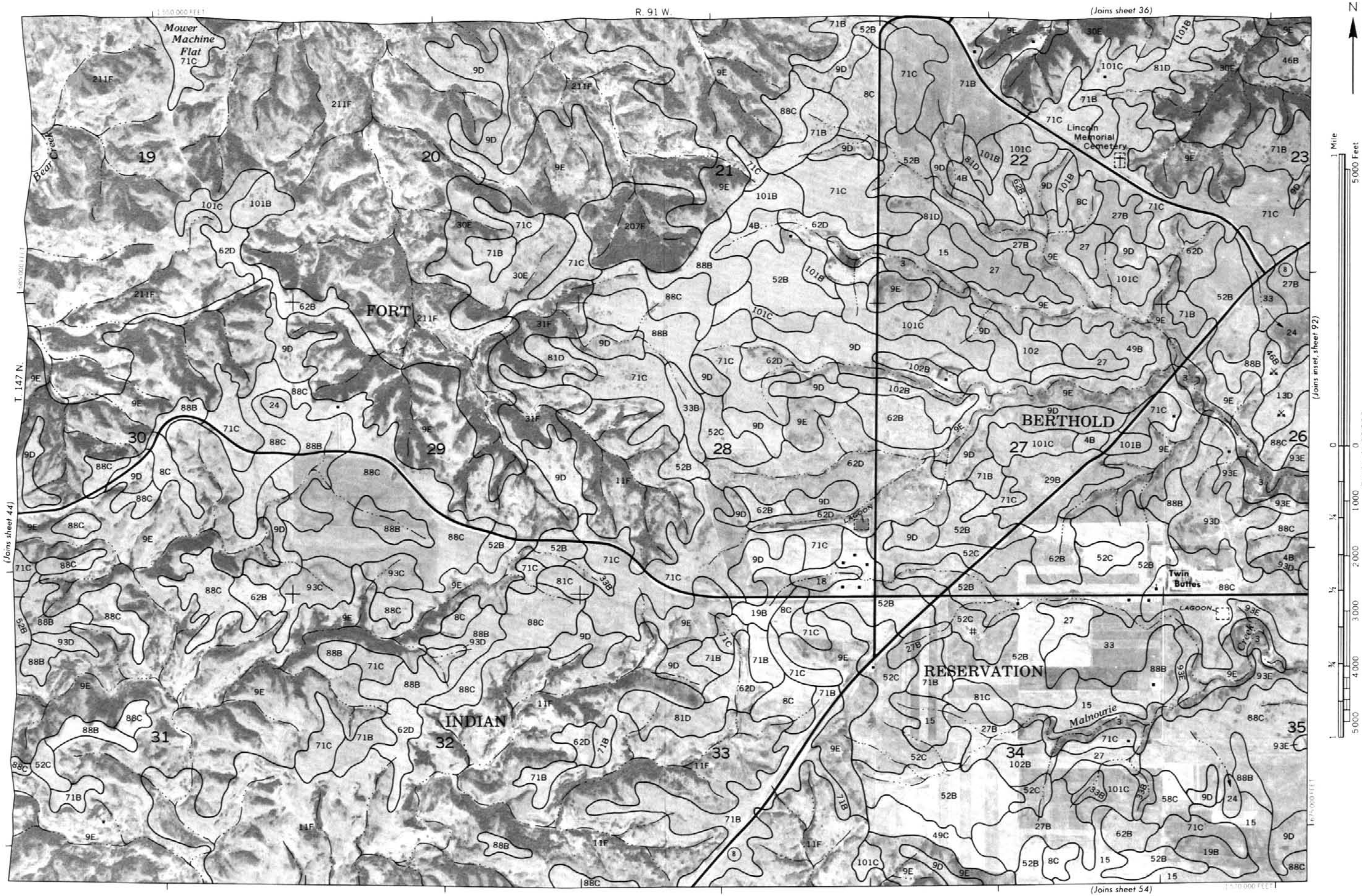
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

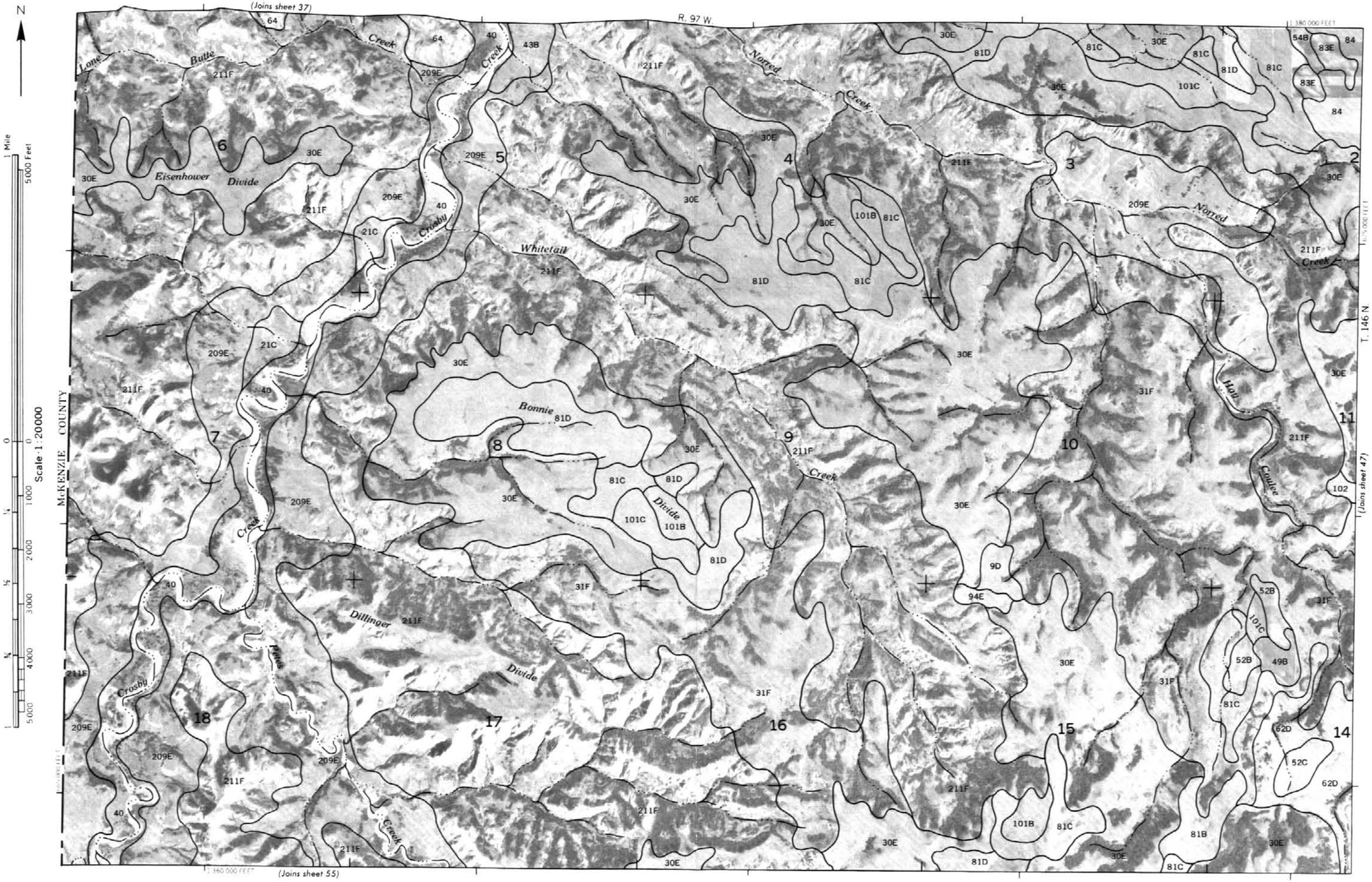
DUNN COUNTY, NORTH DAKOTA NO. 44

45

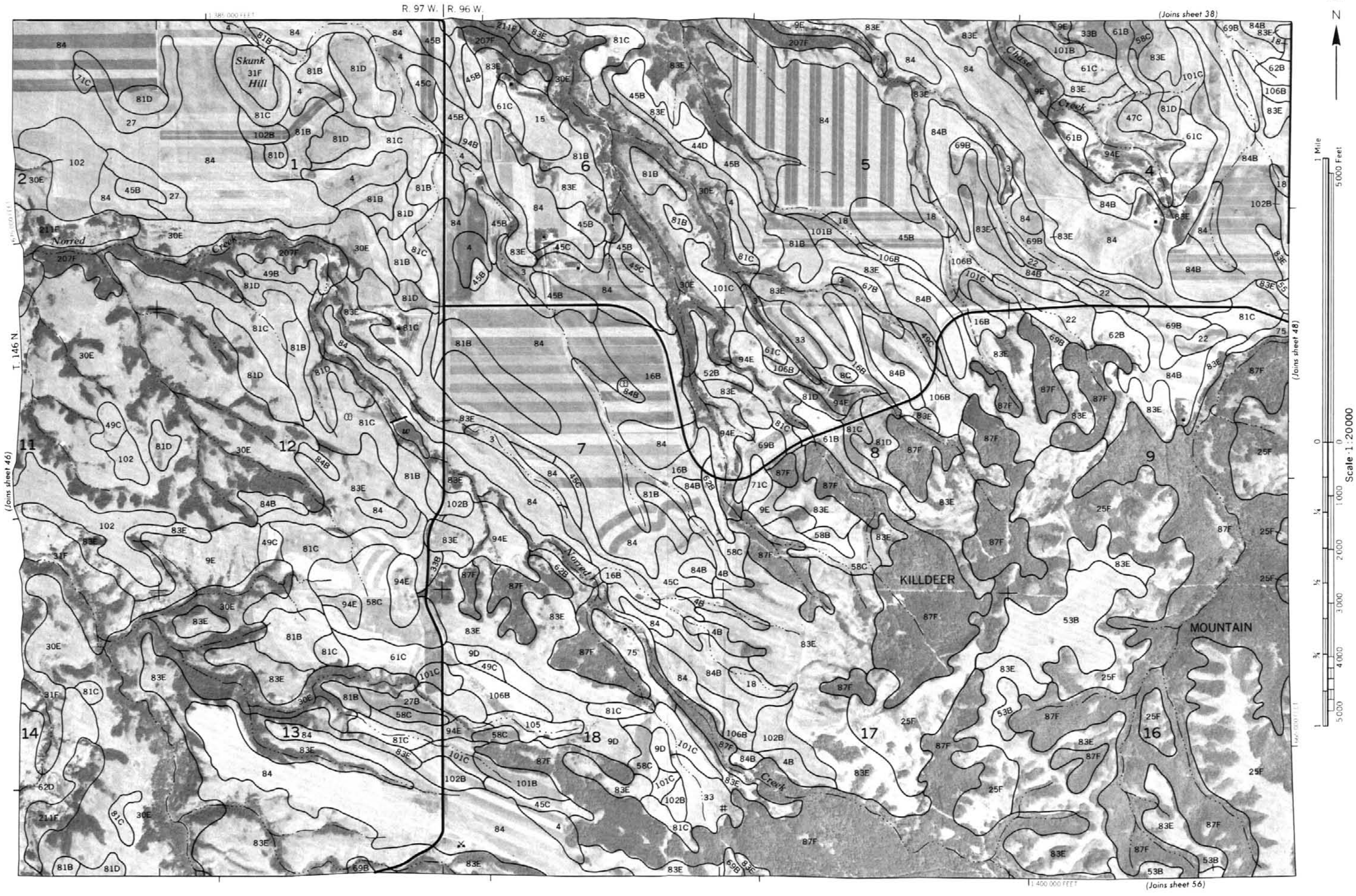


DUNN COUNTY, NORTH DAKOTA NO. 45

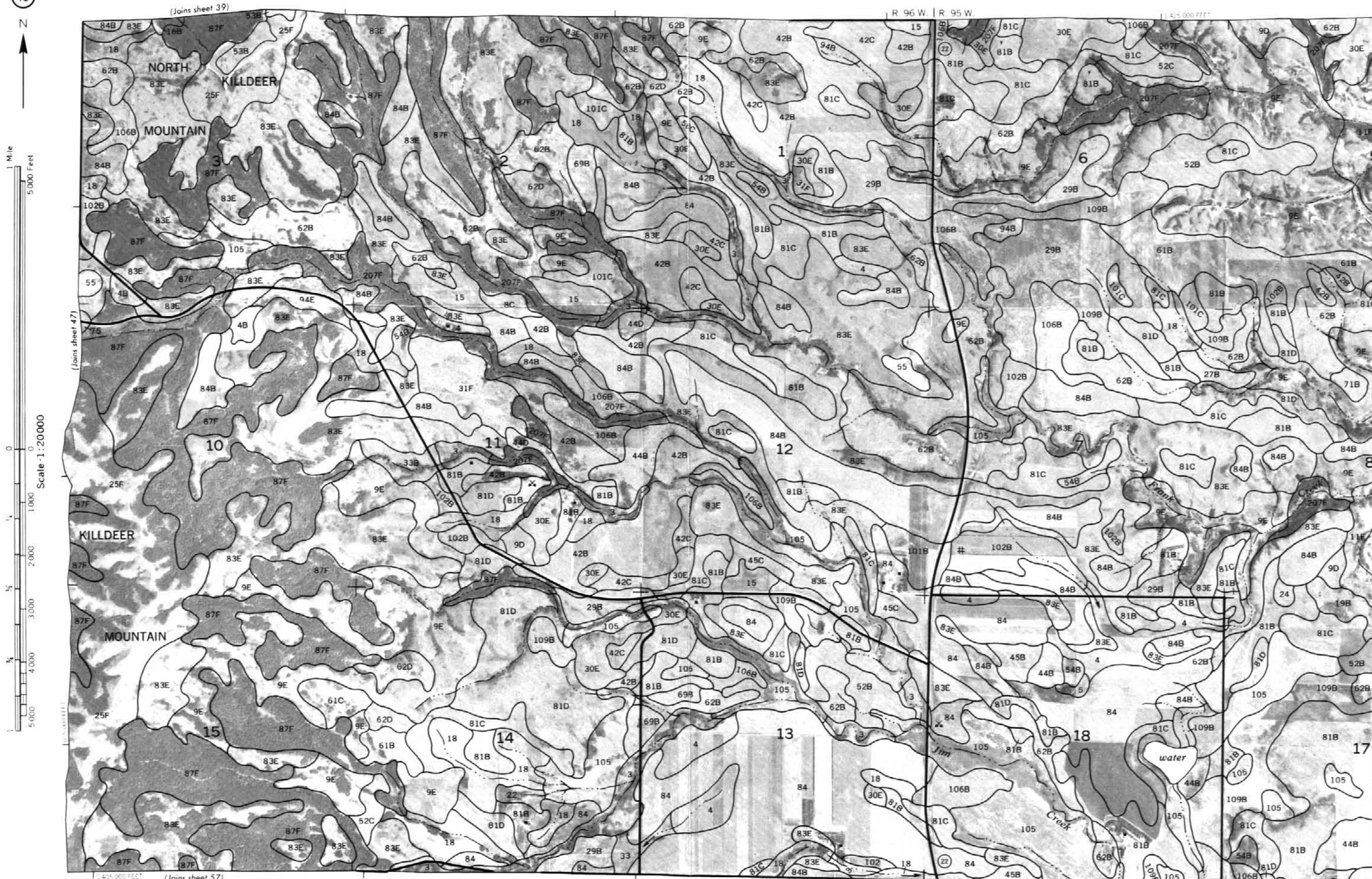
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

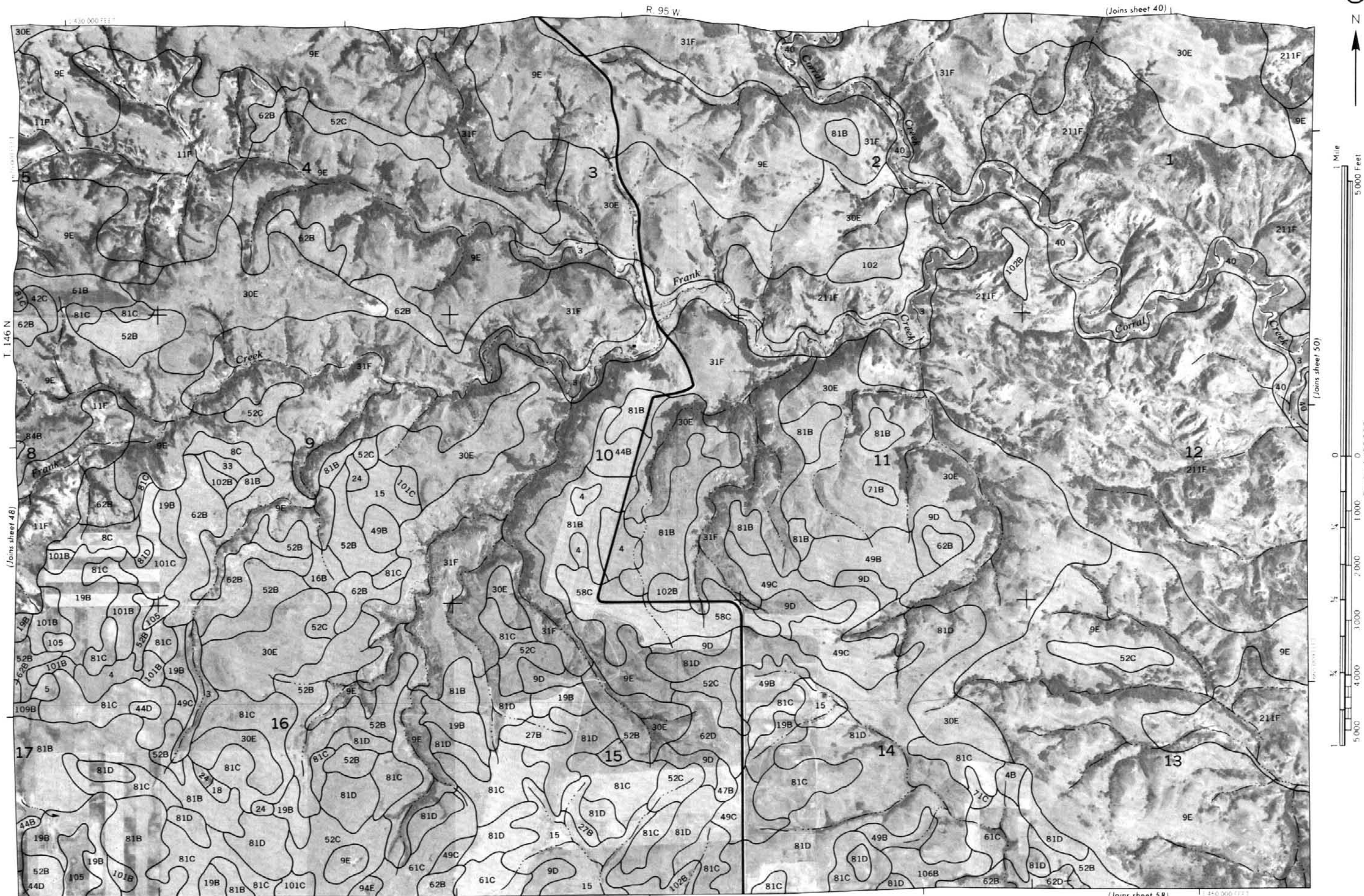


This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



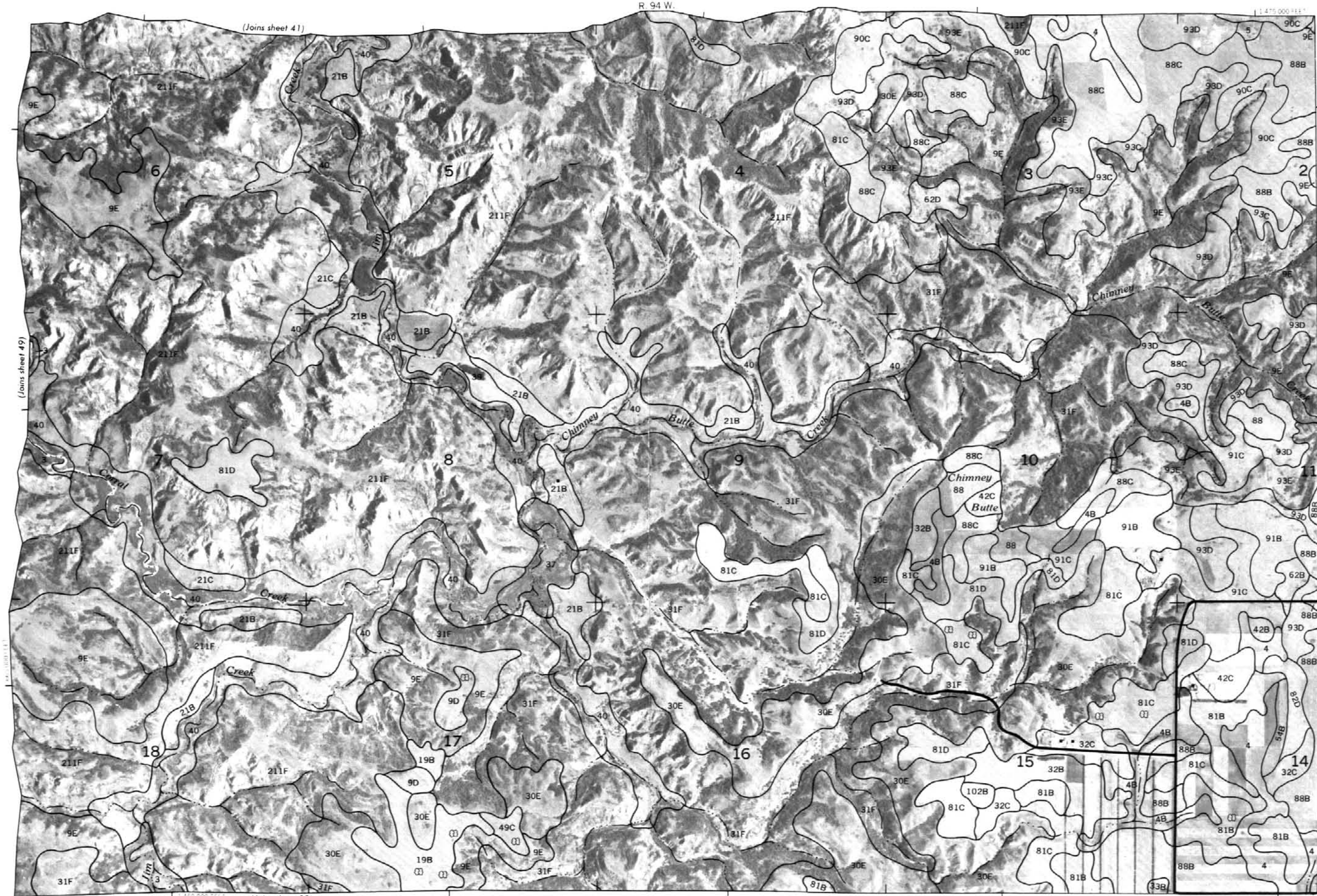
DUNN COUNTY, NORTH DAKOTA NO. 47


N
(Joins sheet 39)
NORTH KILLDEER MOUNTAIN
KILLDEER MOUNTAIN
R. 96 W. | R. 95 W.
T. 146 N
(Joins sheet 47)
(Joins sheet 49)
(Joins sheet 57)
1,405,000 FEET
Scale 1:20000
1 Mile
5 000 Feet
Frank Creek
Jim Creek
water



DUNN COUNTY, NORTH DAKOTA NO. 49

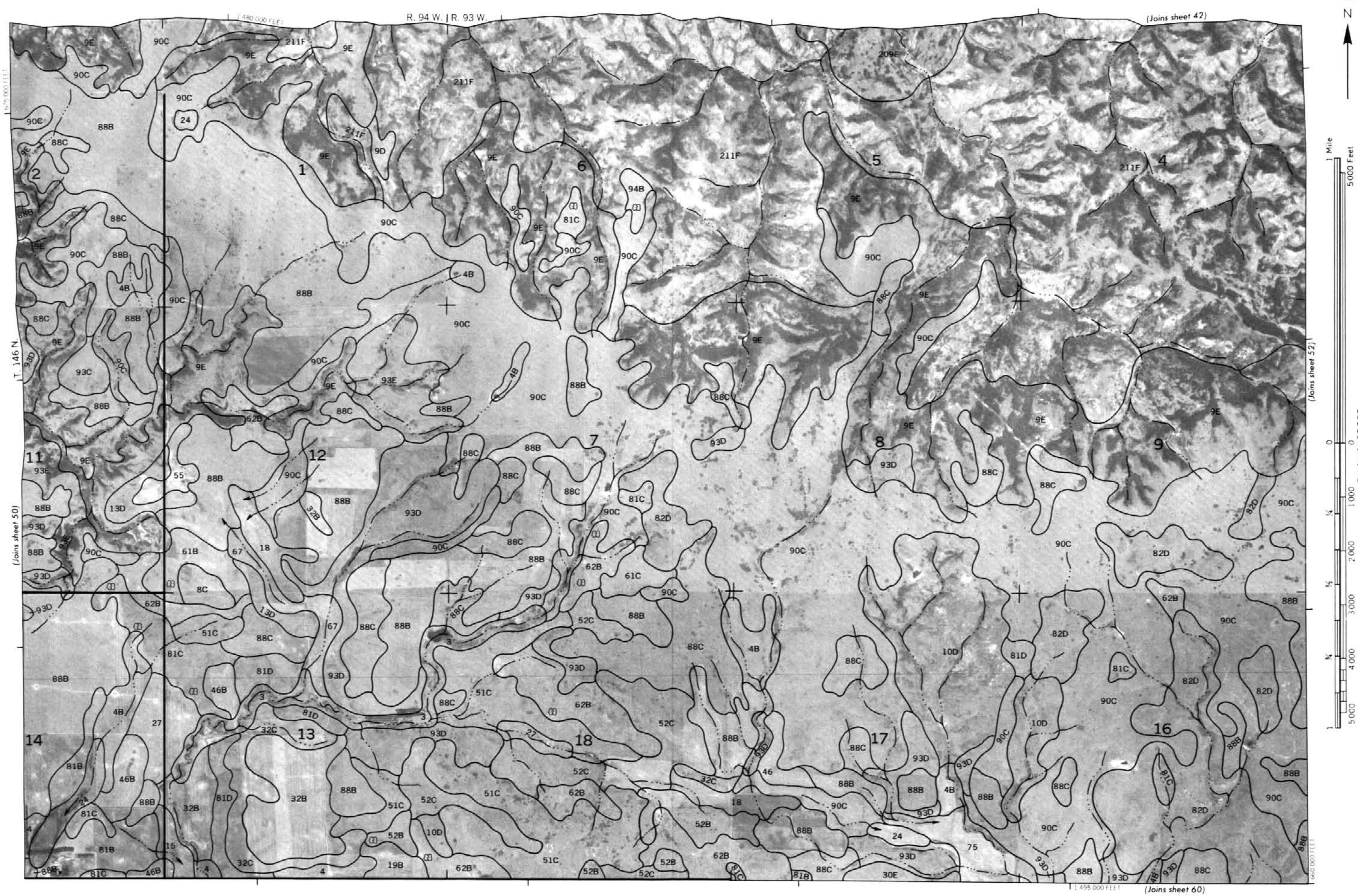
N

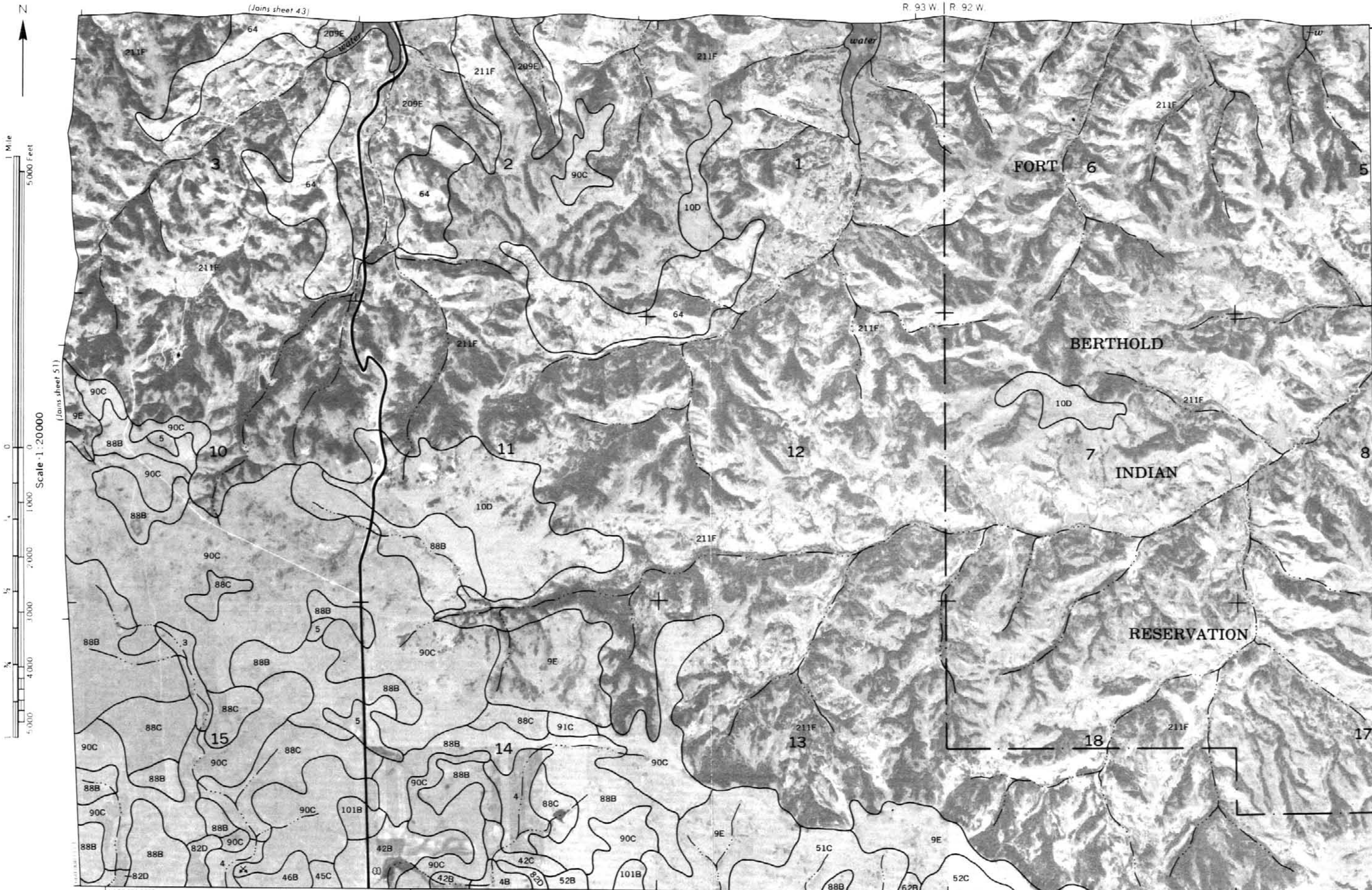


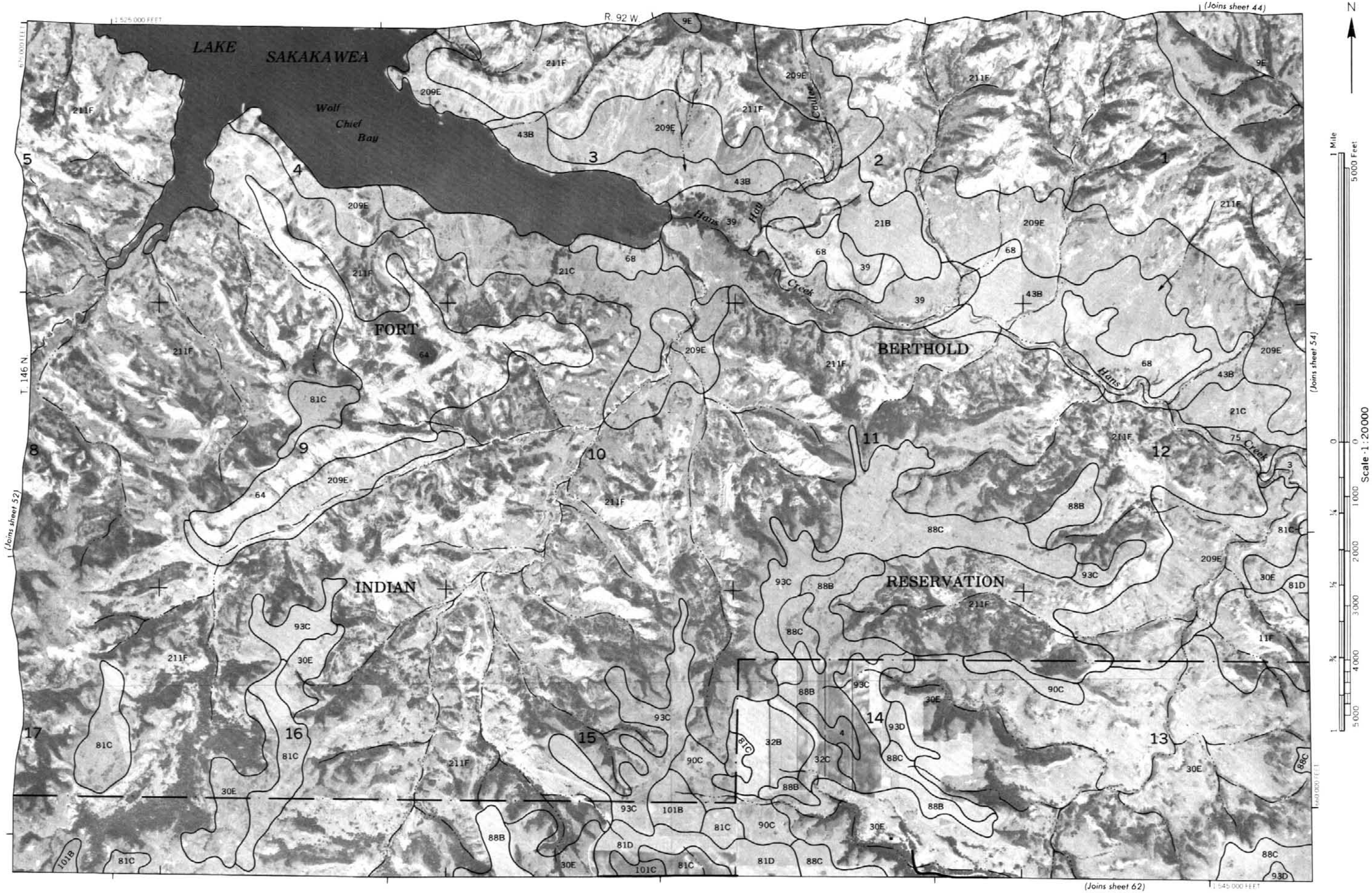
1 Mile
5000 Feet
Scale 1:20000
0
1000
2000
3000
4000
5000

DUNN COUNTY, NORTH DAKOTA NO. 50

51


R. 94 W. | R. 93 W.
(Joins sheet 42)
(Joins sheet 50)
(Joins sheet 52)
(Joins sheet 60)
T. 146 N.
1 480 000 FEET
1 495 000 FEET
N
1 Mile
5000 Feet
Scale 1:20000

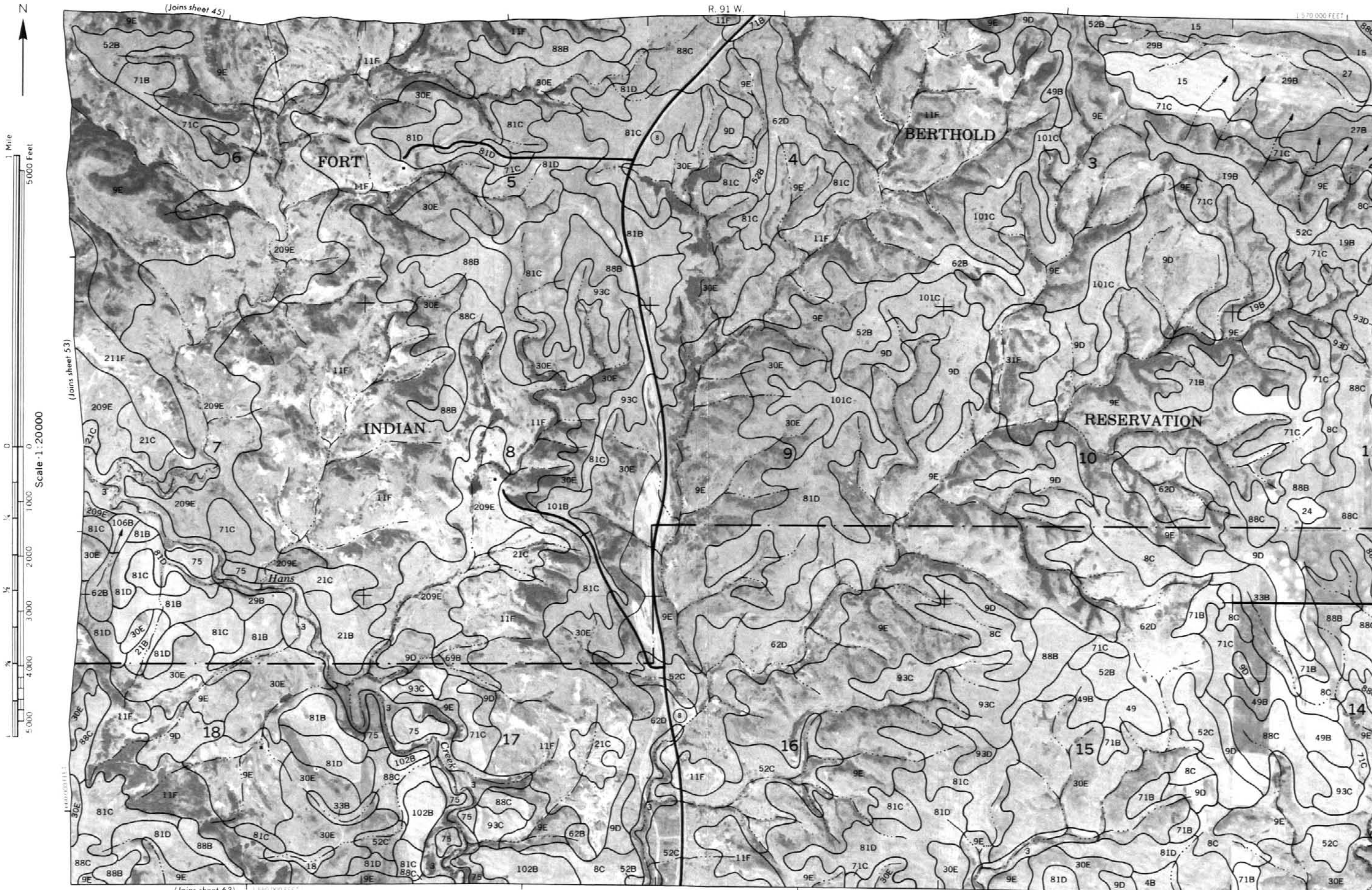

N
1 Mile
5000 Feet
0
1000
2000
3000
4000
5000
Scale 1:20000
(Joins sheet 43)
(Joins sheet 51)
(Joins sheet 53)
(Joins sheet 61)
R. 93 W. | R. 92 W.
T. 146 N.
FORT
BERTHOLD
INDIAN
RESERVATION
water
w
1
2
3
5
6
7
8
10
11
12
13
14
15
17
18
211F
209E
64
90C
10D
9E
88B
88C
5
3
4
91C
101B
82D
42B
42C
46B
45C
4B
82D
52B
51C
62B
52C
9E

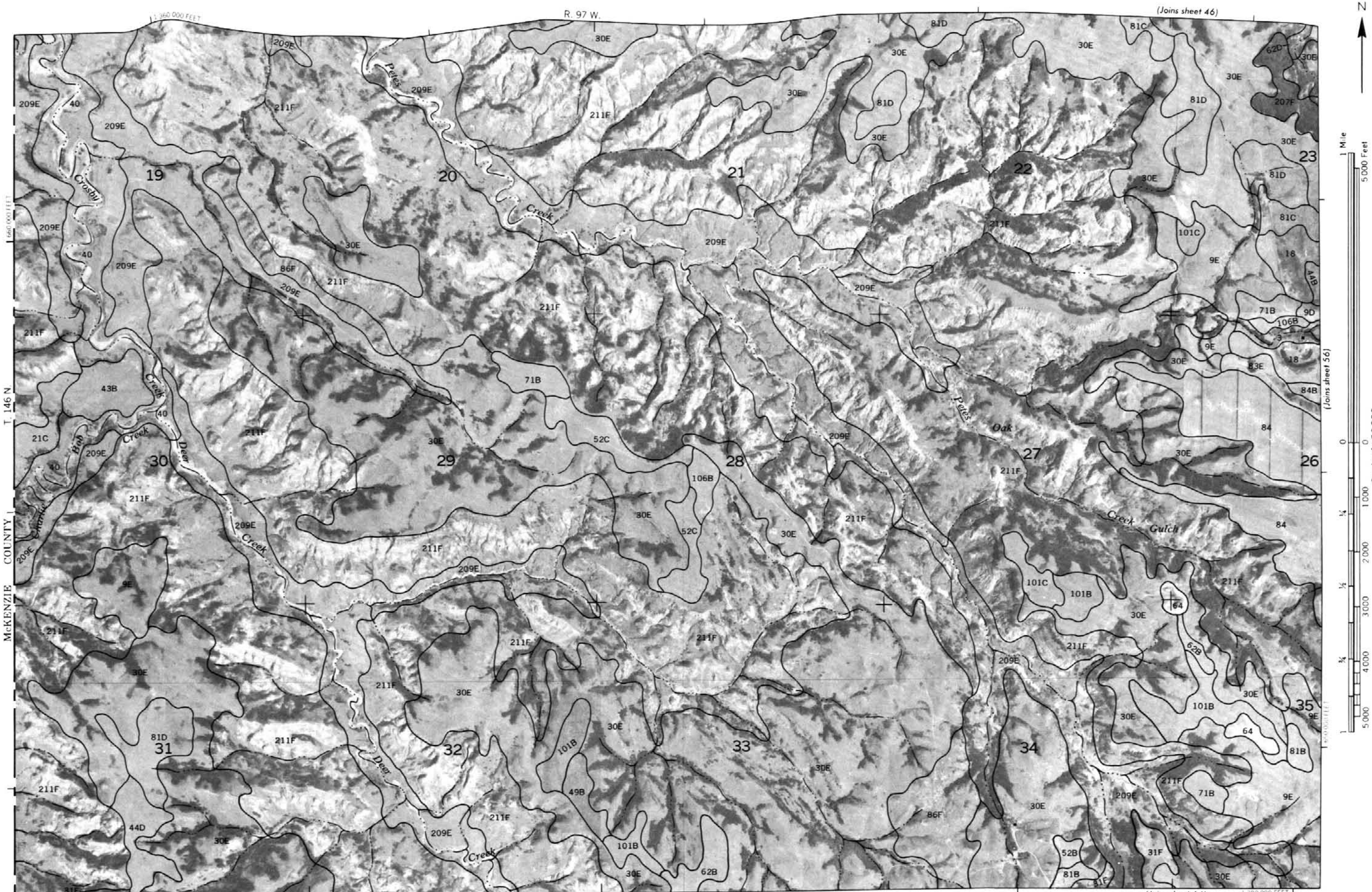


DUNN COUNTY, NORTH DAKOTA NO. 53

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

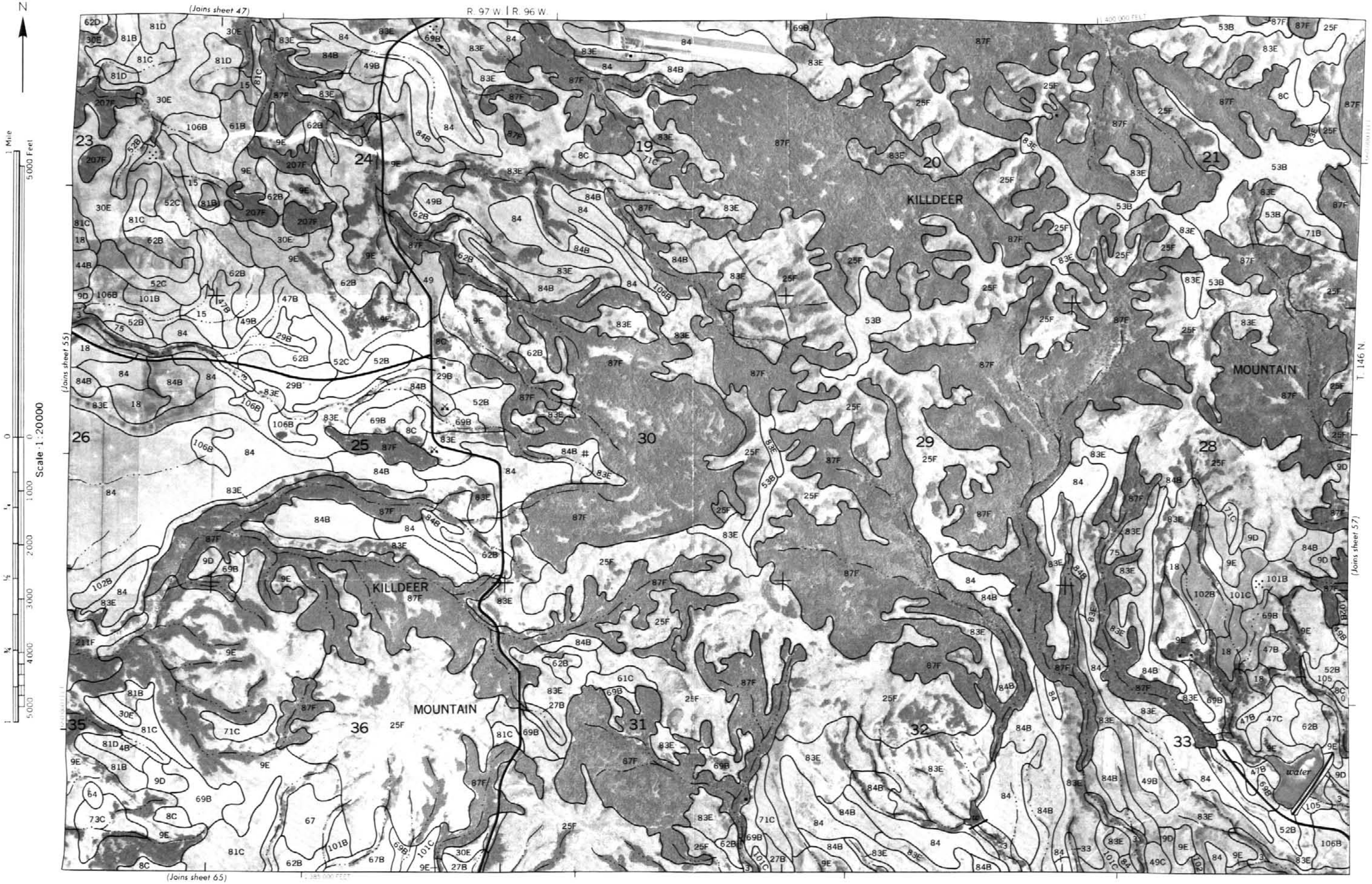
DUNN COUNTY, NORTH DAKOTA — SHEET NUMBER 54

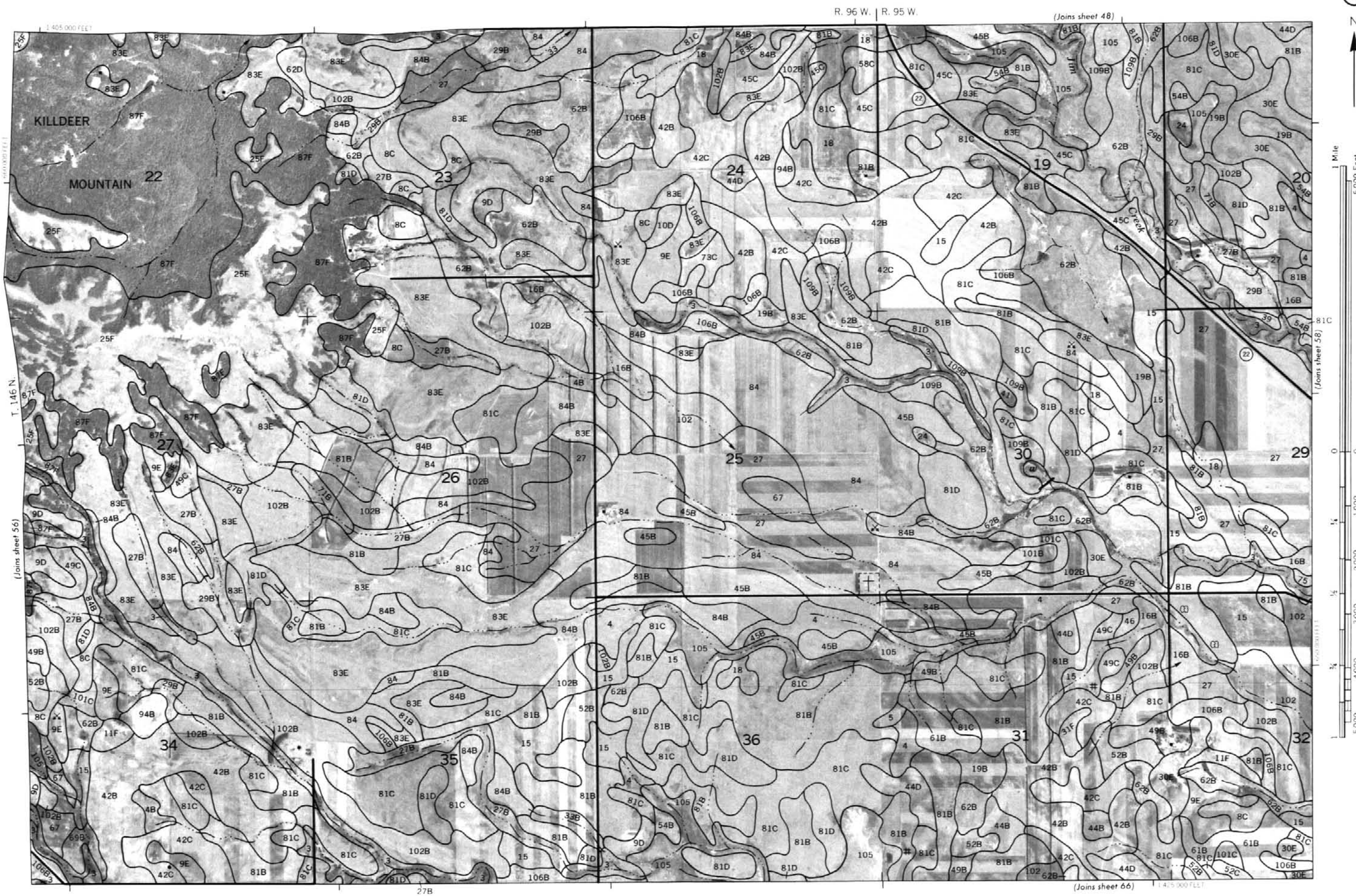




DUNN COUNTY, NORTH DAKOTA NO. 55

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

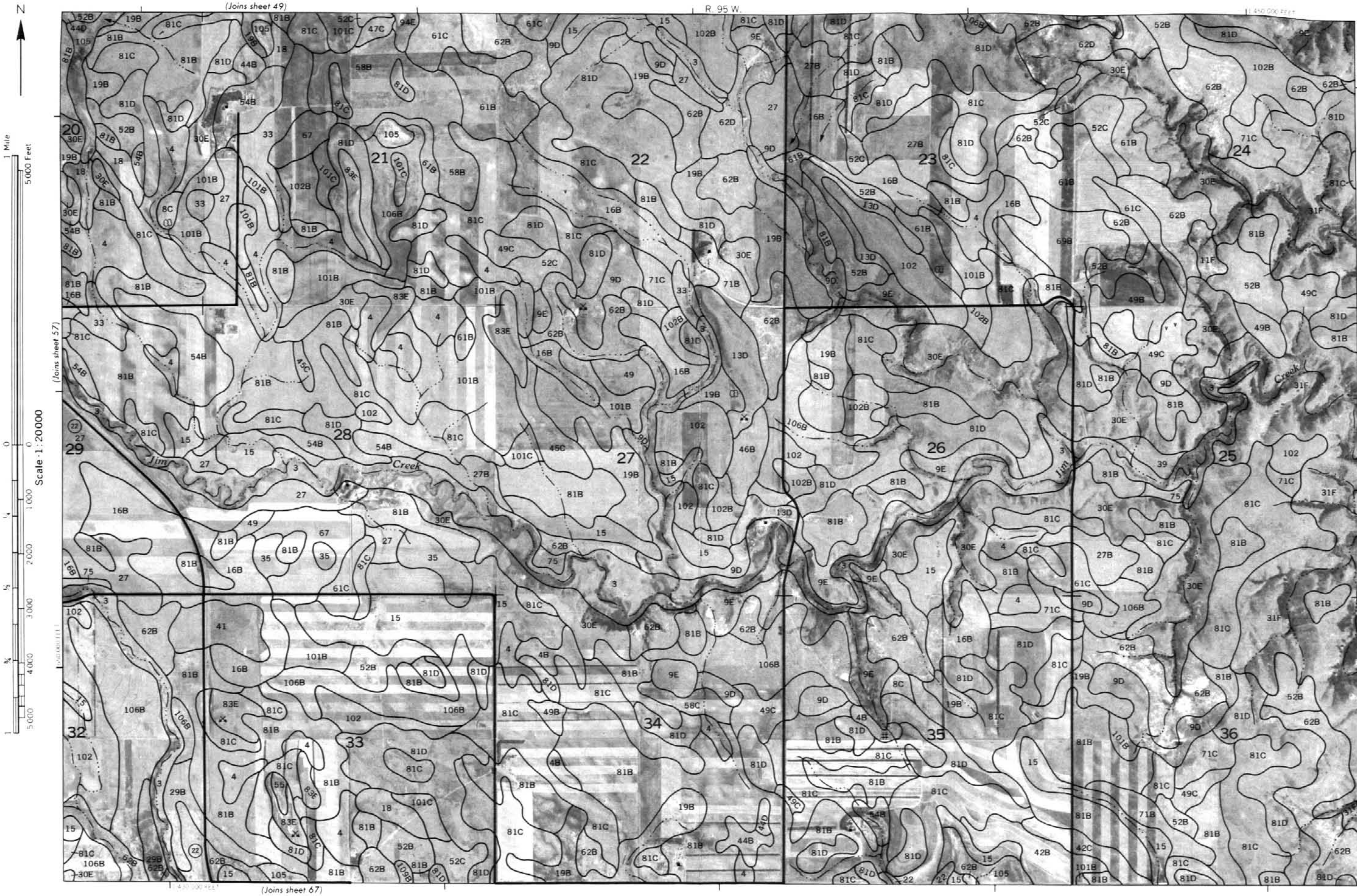

N
1 Mile
5000 Feet
Scale 1:20000
(Joins sheet 47)
R. 97 W. | R. 96 W.
1 400 000 FEET
(Joins sheet 55)
(Joins sheet 57)
(Joins sheet 65)
T. 146 N.
1 385 000 FEET
KILLDEER
MOUNTAIN
KILLDEER
MOUNTAIN
water
19
20
21
23
24
25
26
28
29
30
31
32
33
35
36
DUNN COUNTY, NORTH DAKOTA NO. 56



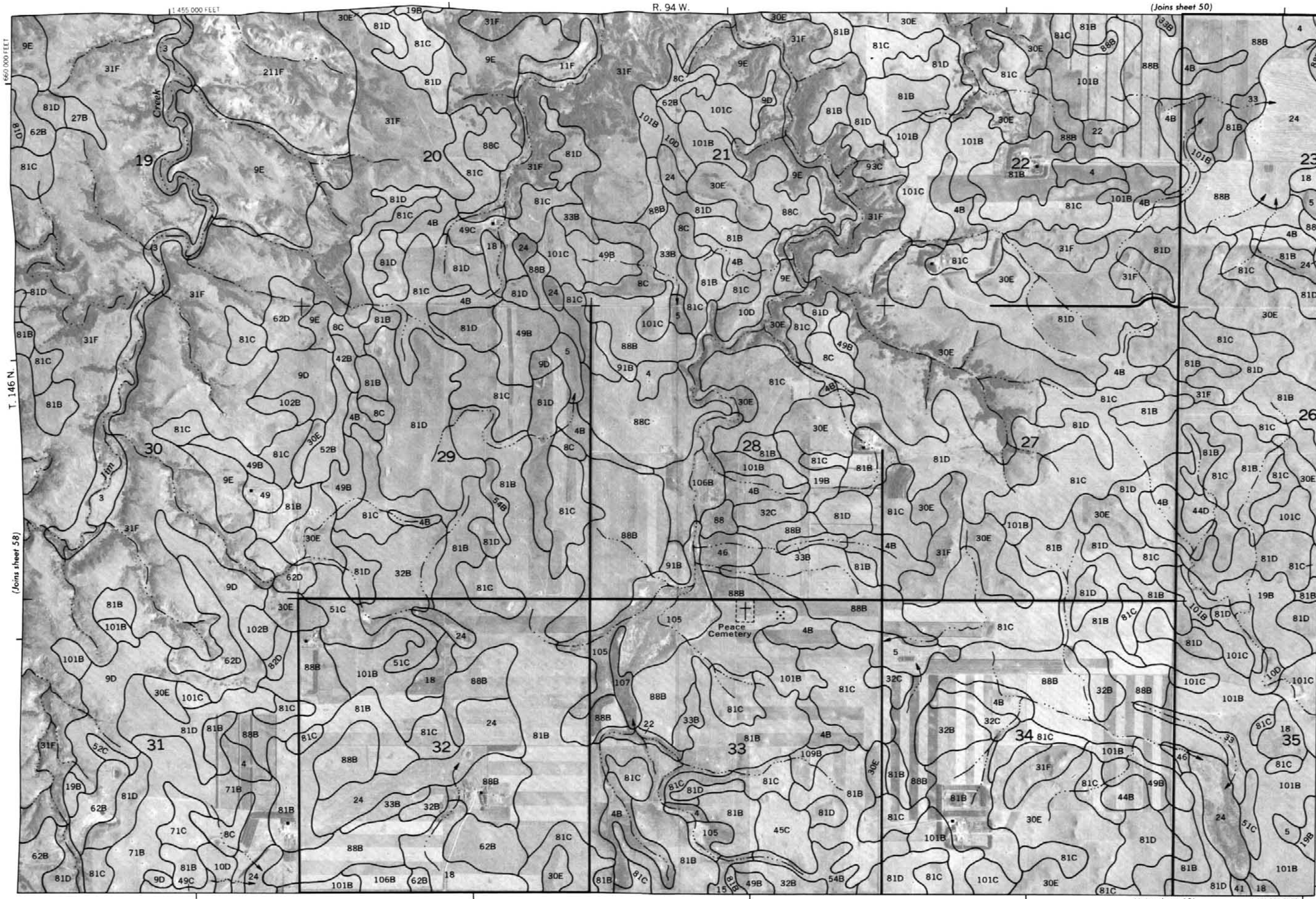
DUNN COUNTY, NORTH DAKOTA NO. 57

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DUNN COUNTY, NORTH DAKOTA — SHEET NUMBER 58



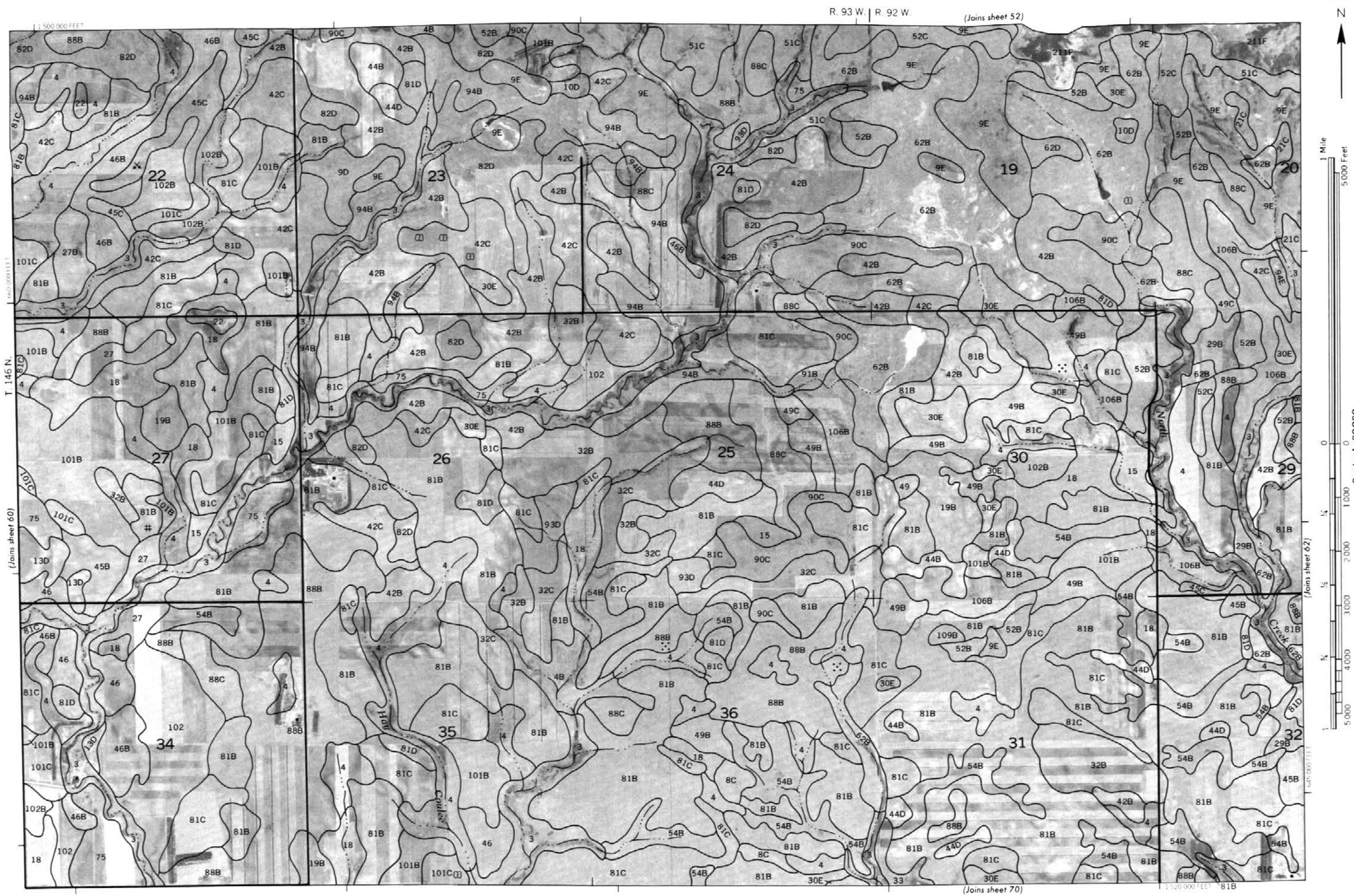
DUNN COUNTY, NORTH DAKOTA NO. 58

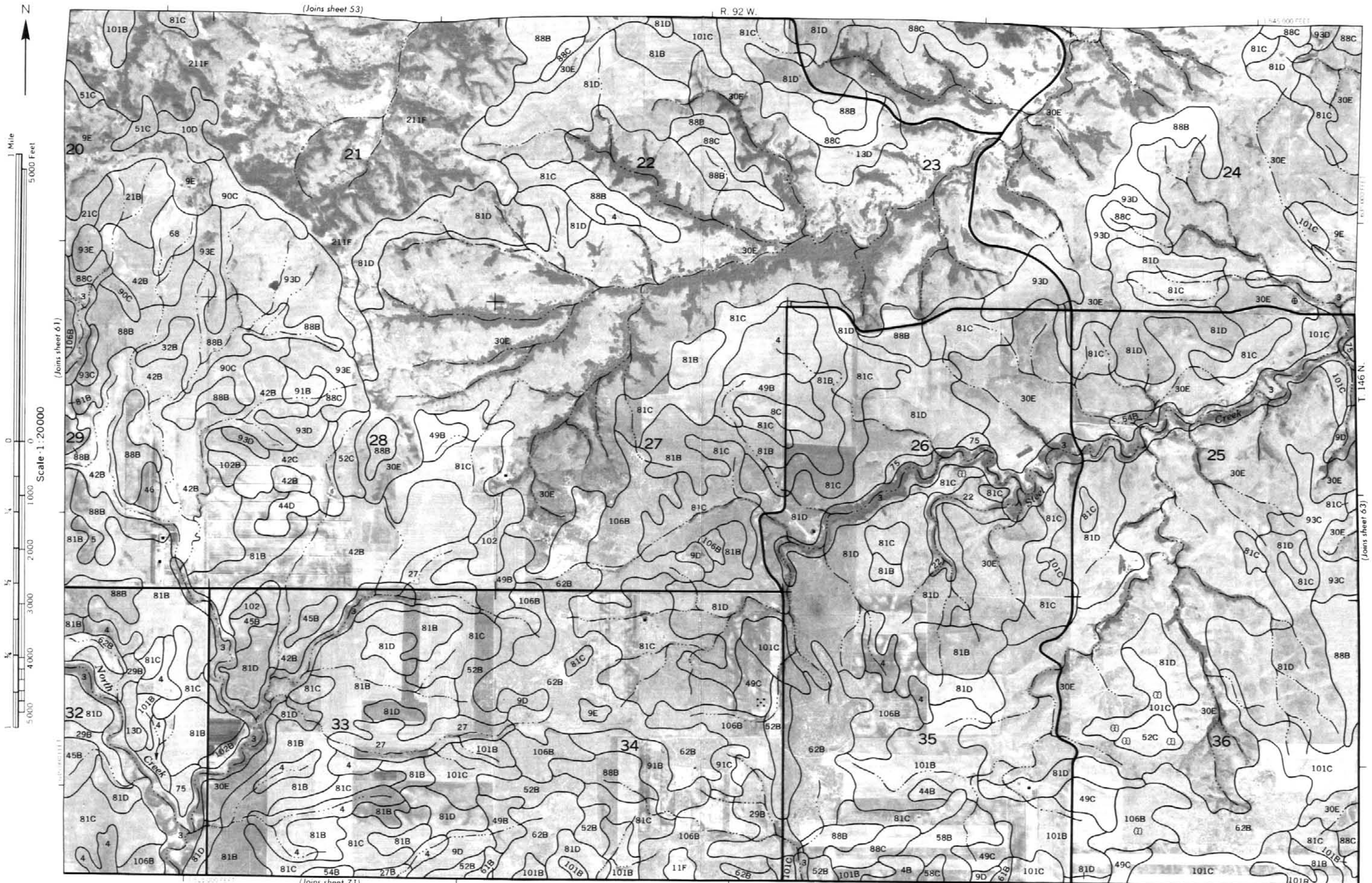


DUNN COUNTY, NORTH DAKOTA NO. 59

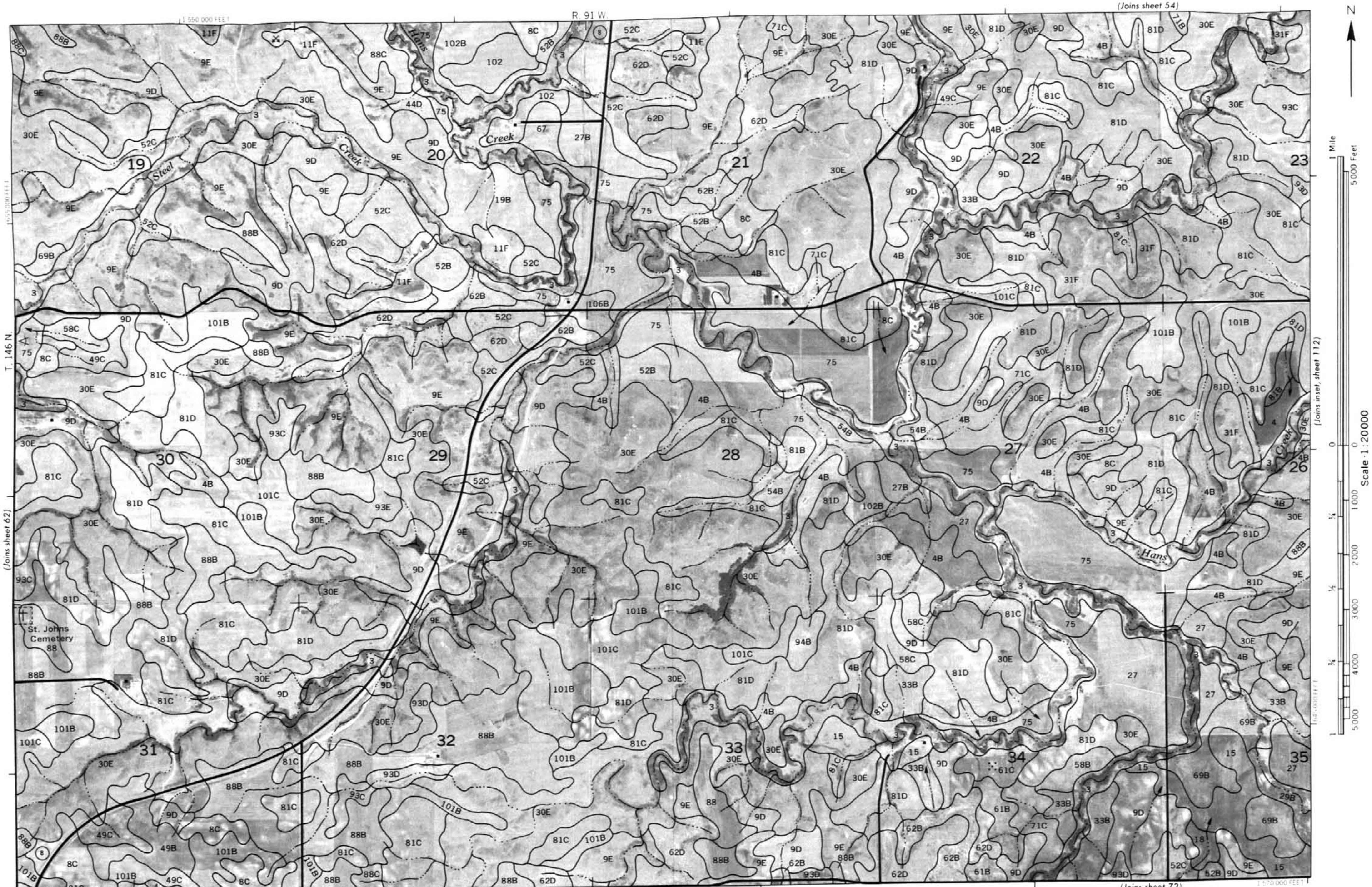
This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.


61
N
R. 93 W. | R. 92 W.
(Joins sheet 52)
(Joins sheet 60)
(Joins sheet 62)
(Joins sheet 70)
T. 146 N.
1 500 000 FEET
1 520 000 FEET
22
23
24
19
20
27
26
25
30
29
34
35
36
31
32
North
Creek
Coulee
1 Mile
5000 Feet
Scale 1:20000
DUNN COUNTY, NORTH DAKOTA NO. 61
This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

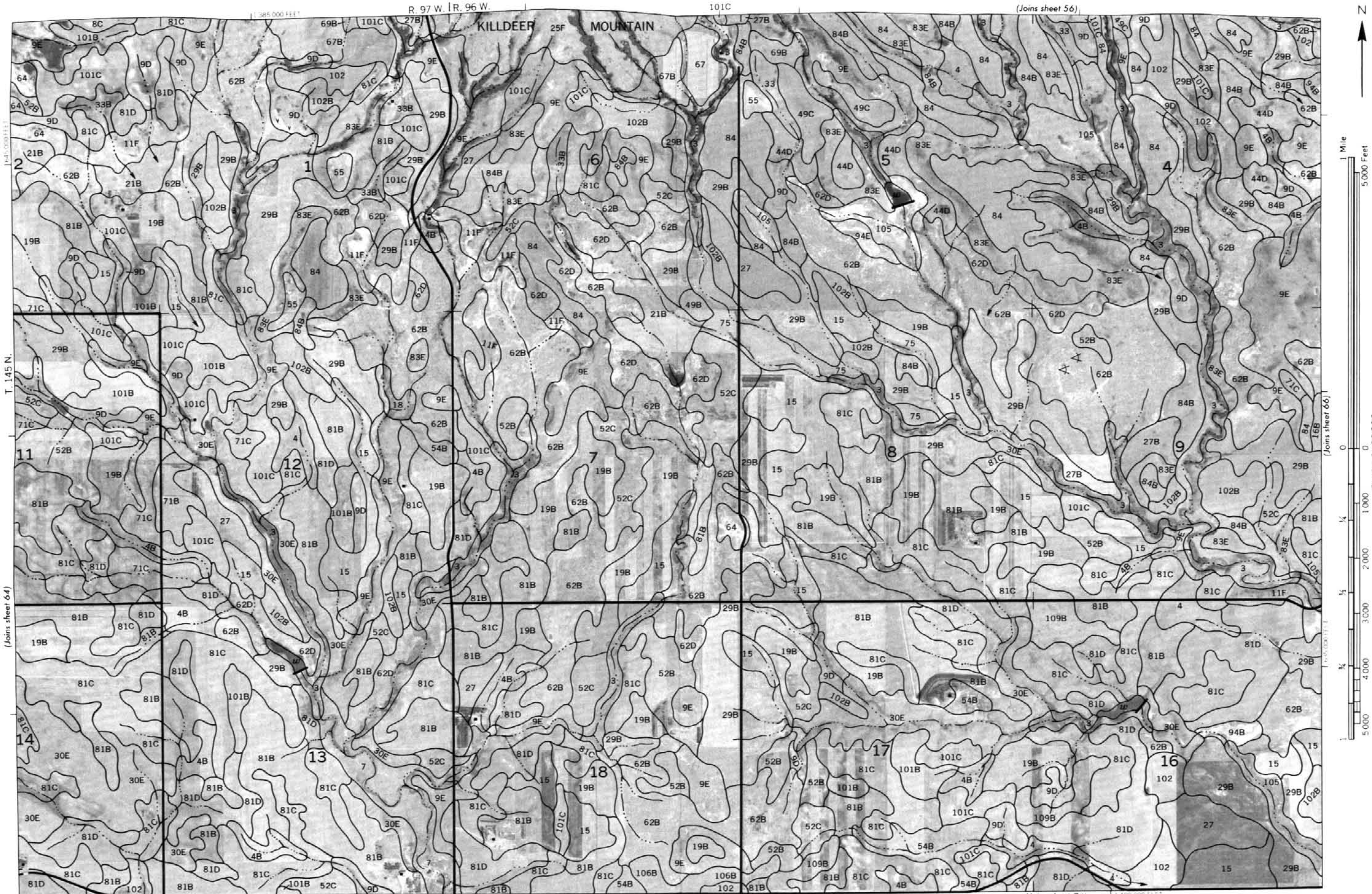


DUNN COUNTY, NORTH DAKOTA NO. 63

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

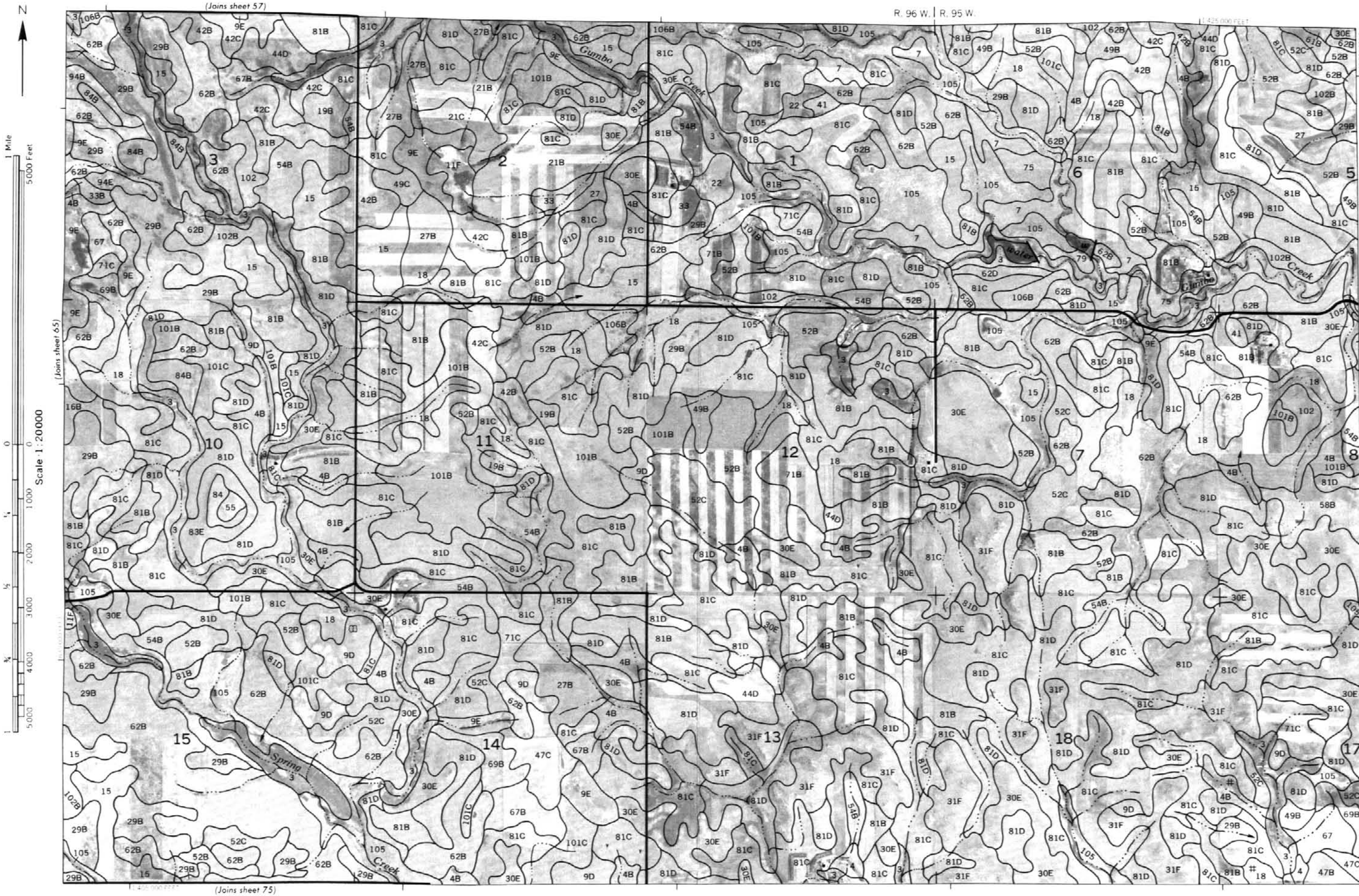
DUNN COUNTY, NORTH DAKOTA — SHEET NUMBER 64

DUNN COUNTY, NORTH DAKOTA NO. 64



DUNN COUNTY, NORTH DAKOTA NO. 65

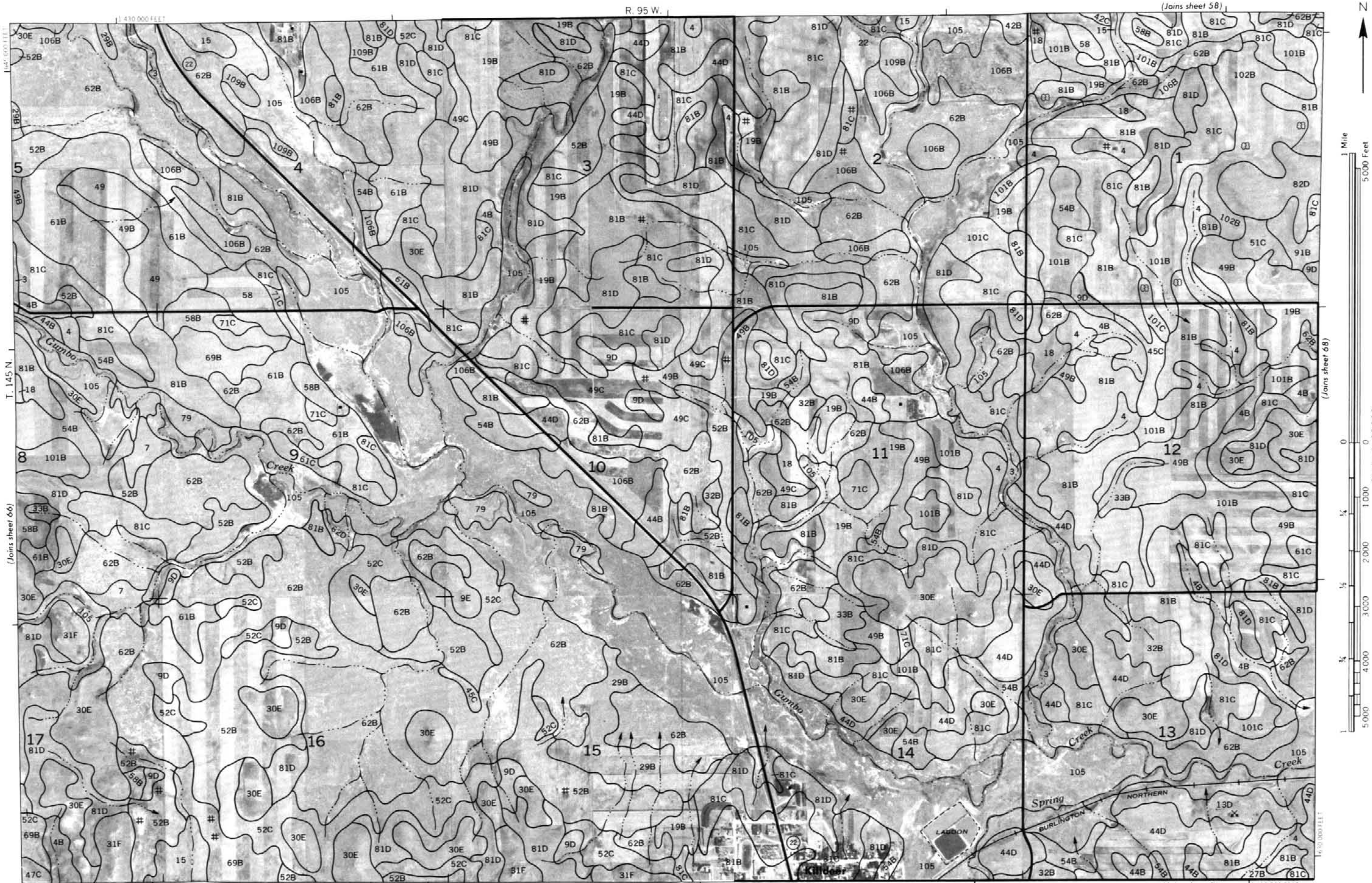
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DUNN COUNTY, NORTH DAKOTA NO. 66

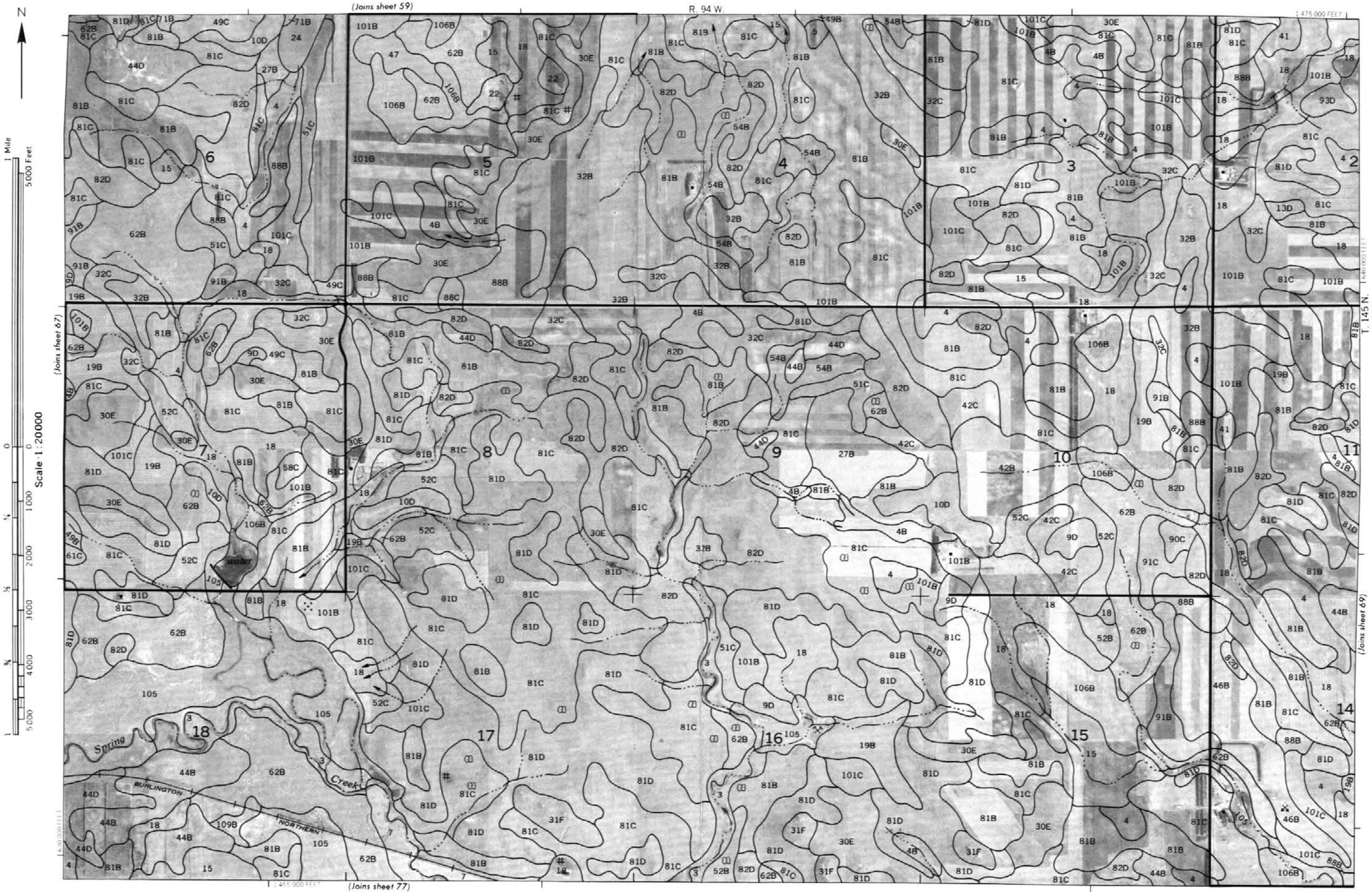
67



DUNN COUNTY, NORTH DAKOTA NO. 67

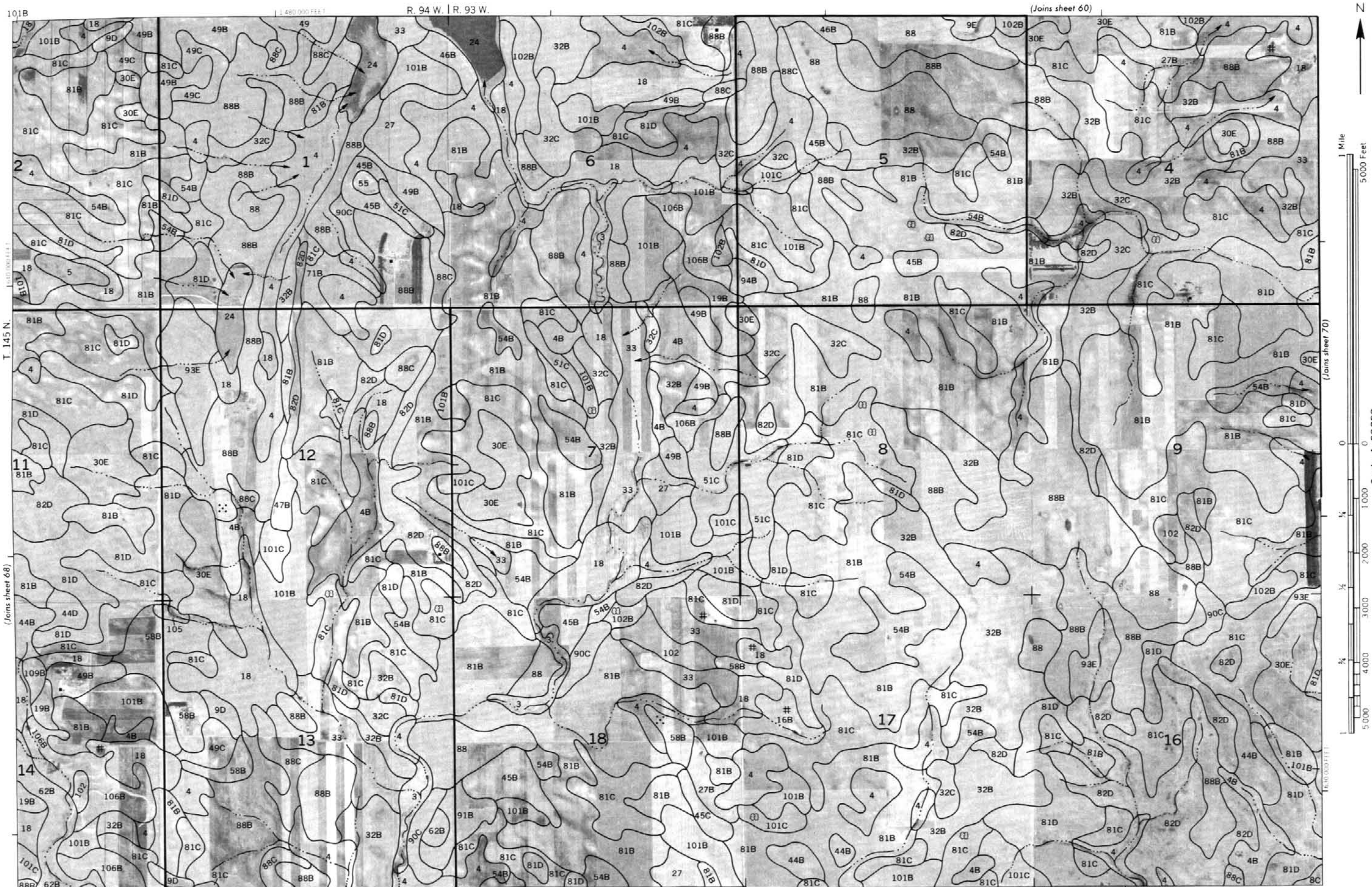
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DUNN COUNTY, NORTH DAKOTA — SHEET NUMBER 68



This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

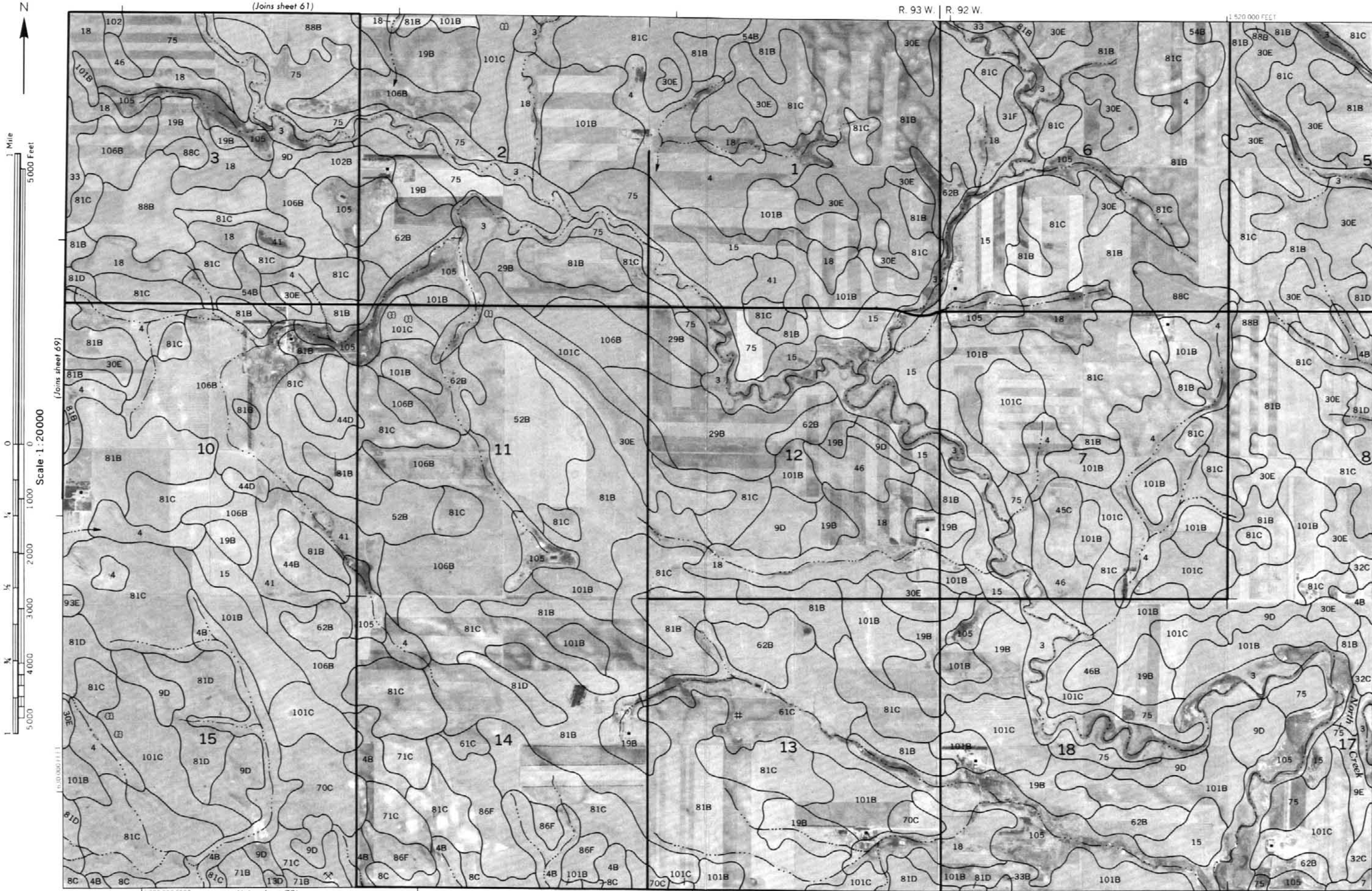
DUNN COUNTY, NORTH DAKOTA NO. 68



DUNN COUNTY, NORTH DAKOTA NO. 69

This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

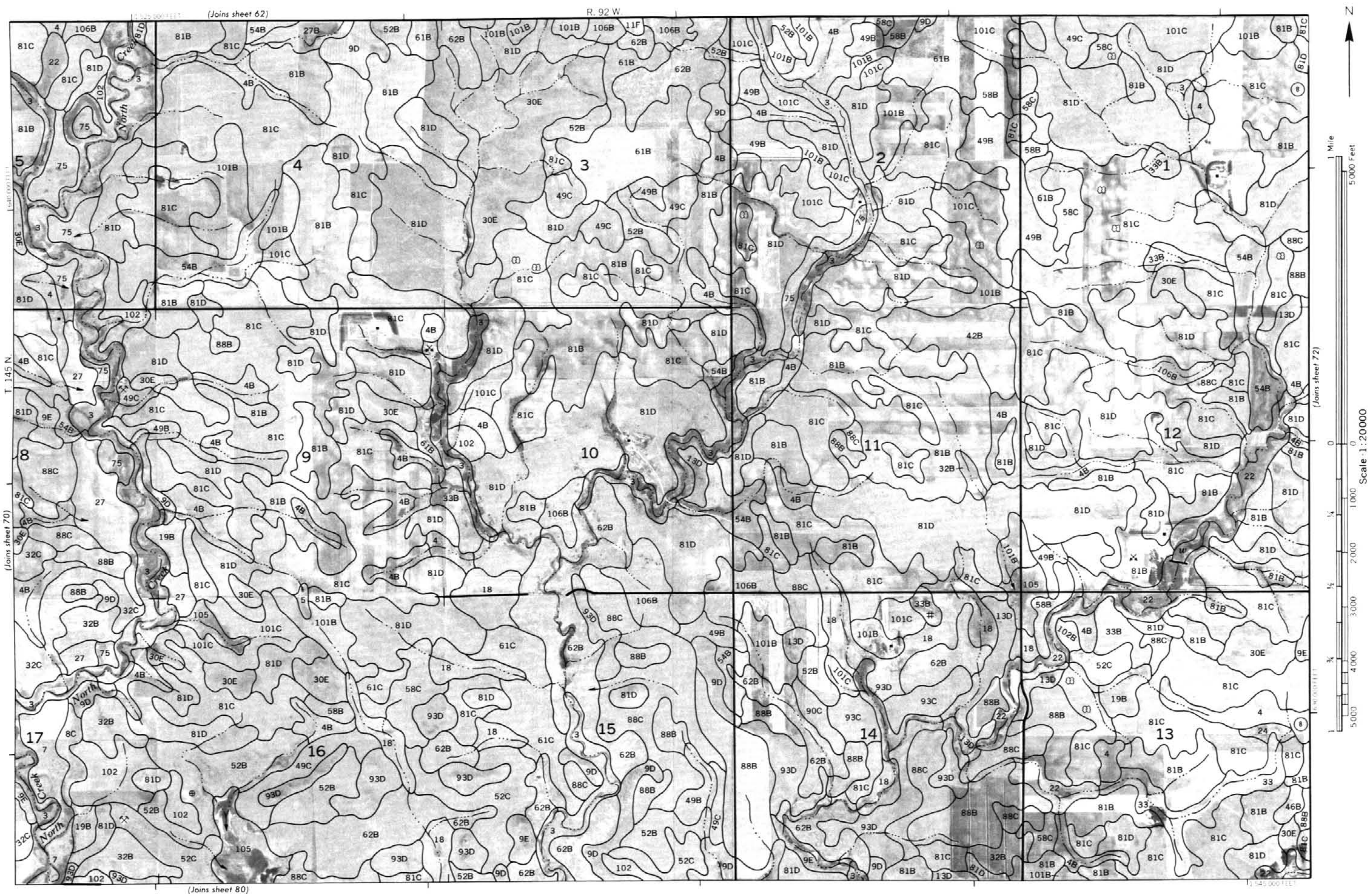
DUNN COUNTY, NORTH DAKOTA — SHEET NUMBER 70



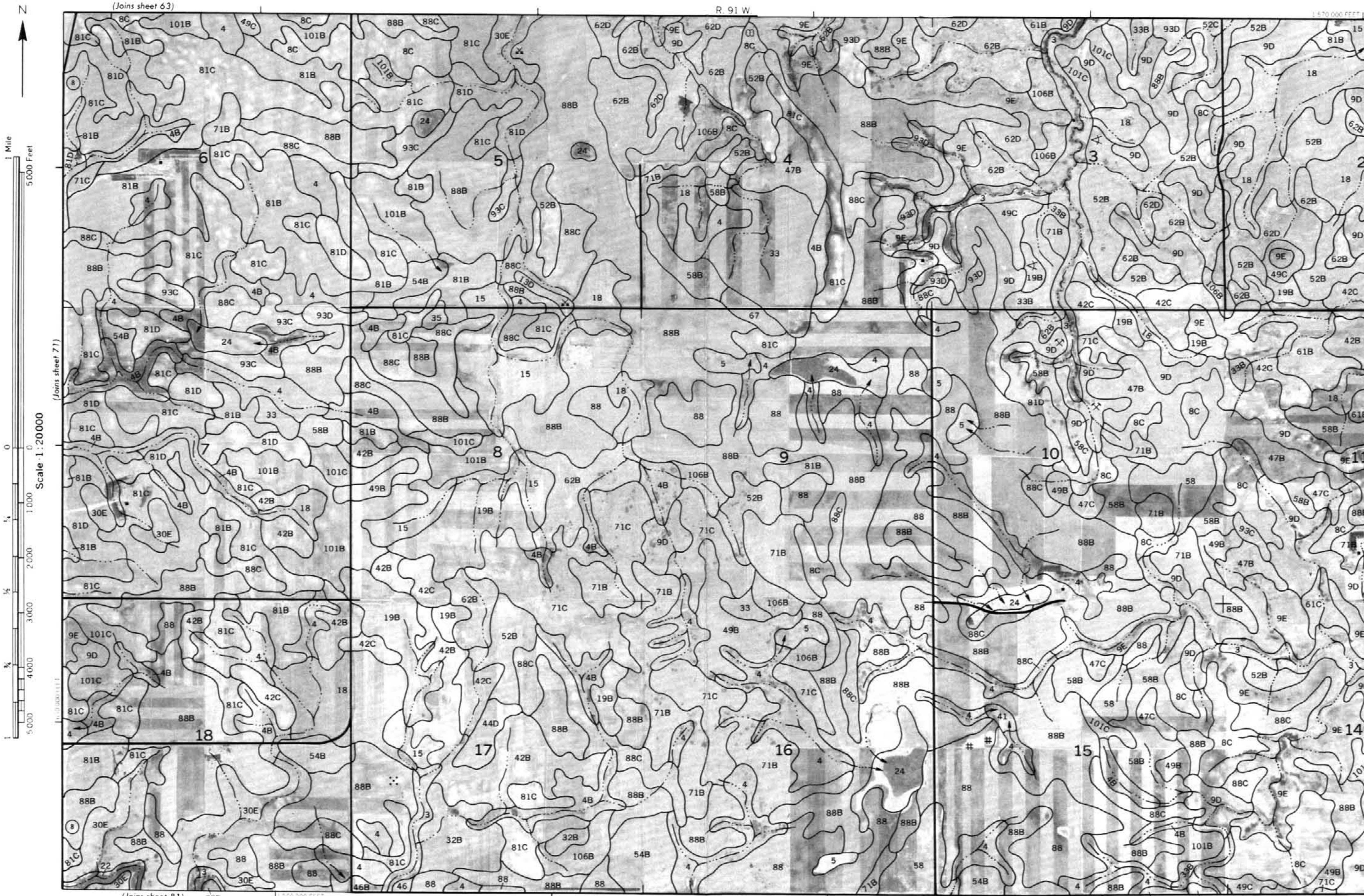
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DUNN COUNTY, NORTH DAKOTA NO. 70

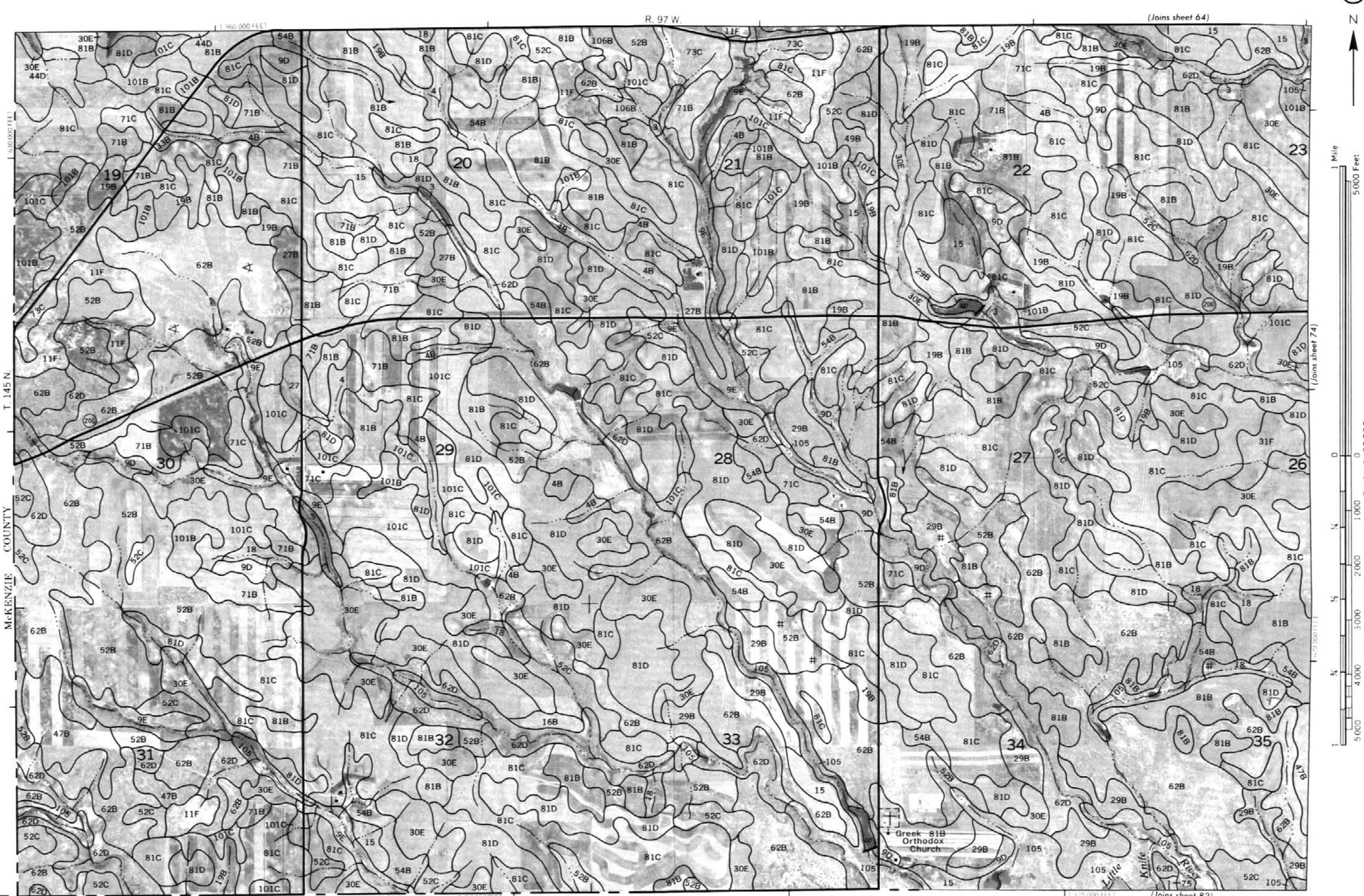
71



DUNN COUNTY, NORTH DAKOTA NO. 71

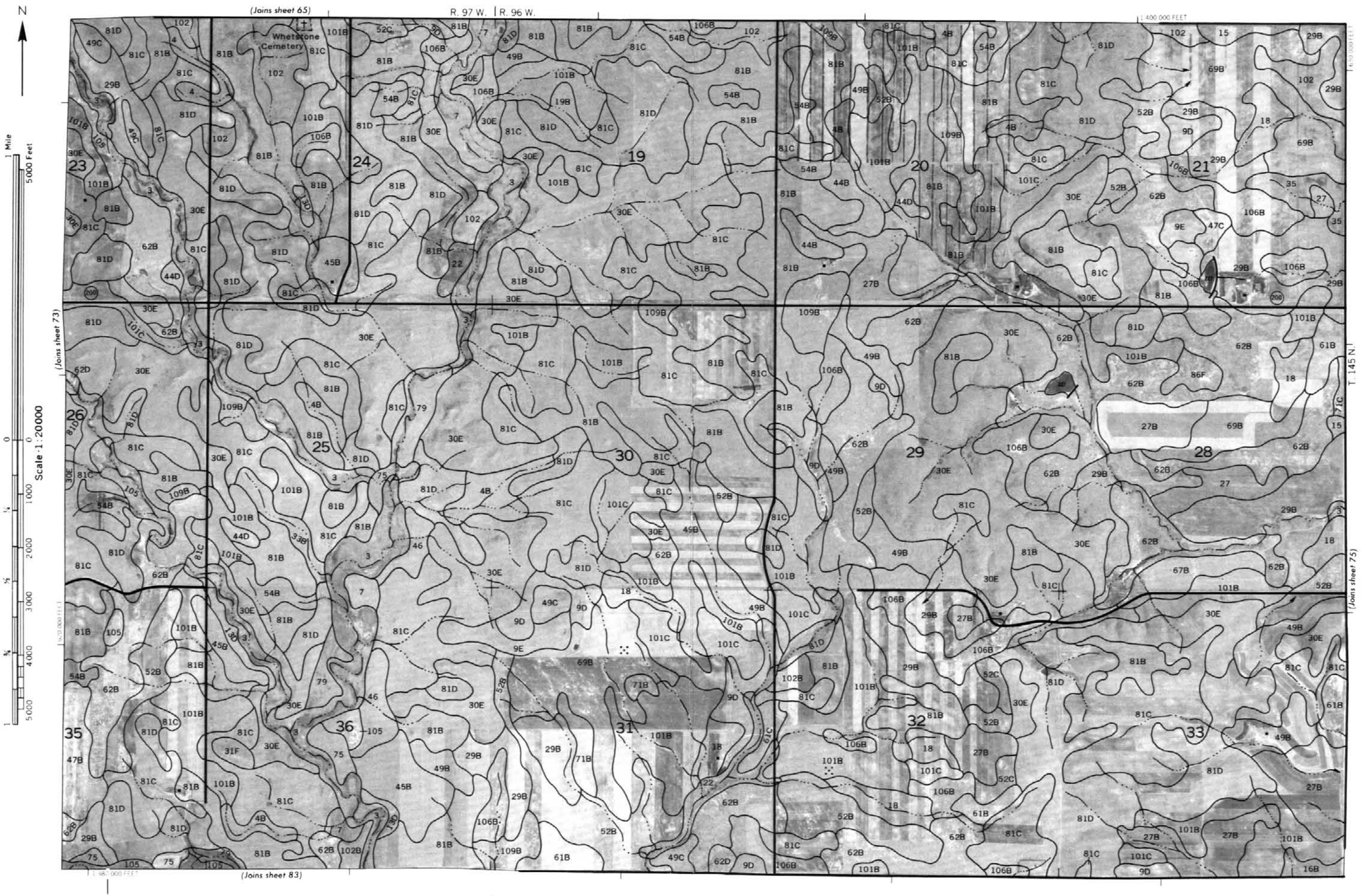


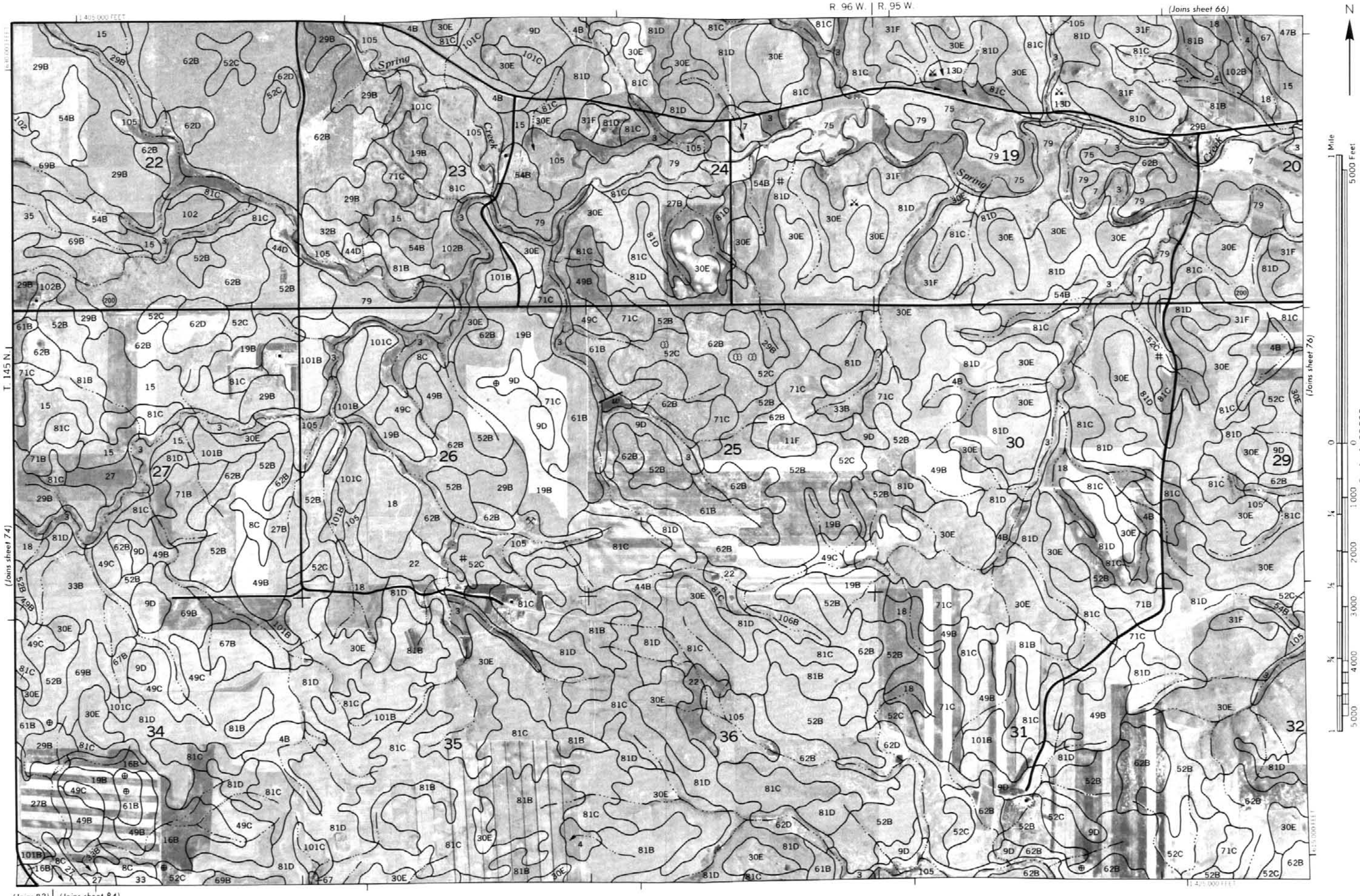
DUNN COUNTY, NORTH DAKOTA NO. 72



DUNN COUNTY, NORTH DAKOTA NO. 73

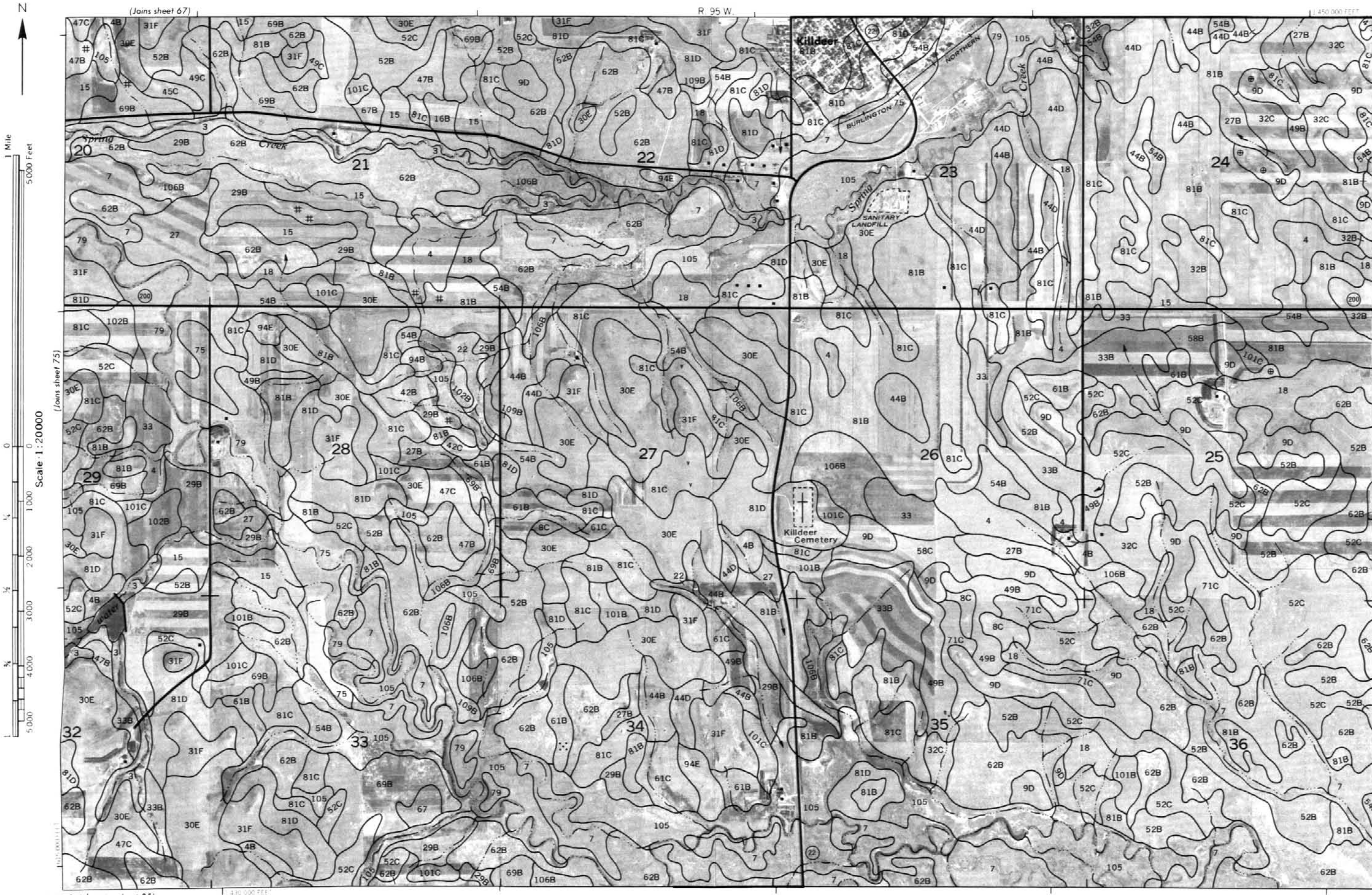
DUNN COUNTY, NORTH DAKOTA — SHEET NUMBER 74





DUNN COUNTY, NORTH DAKOTA NO. 75

This map is compiled on 1974 aerial photographs by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

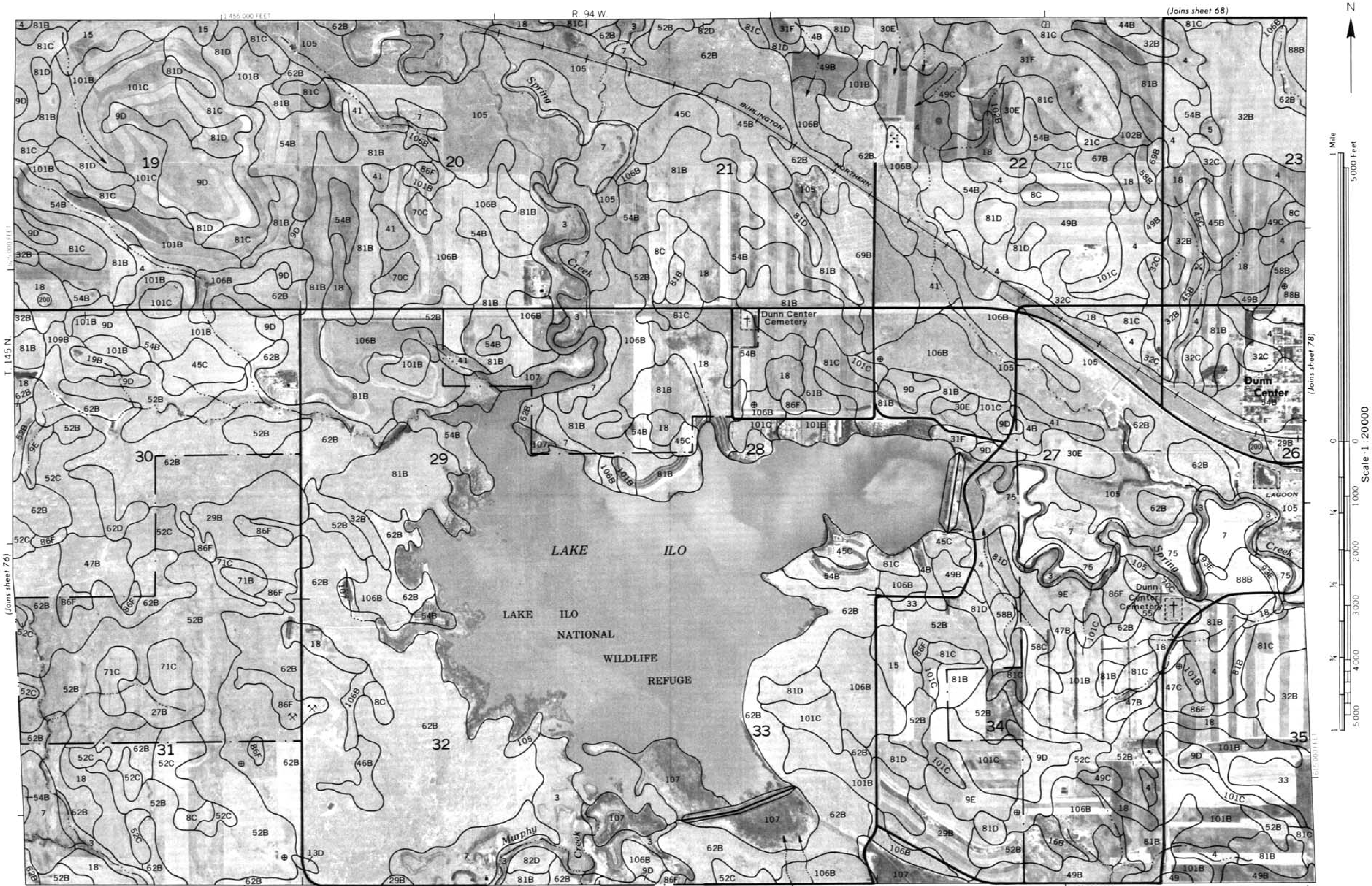


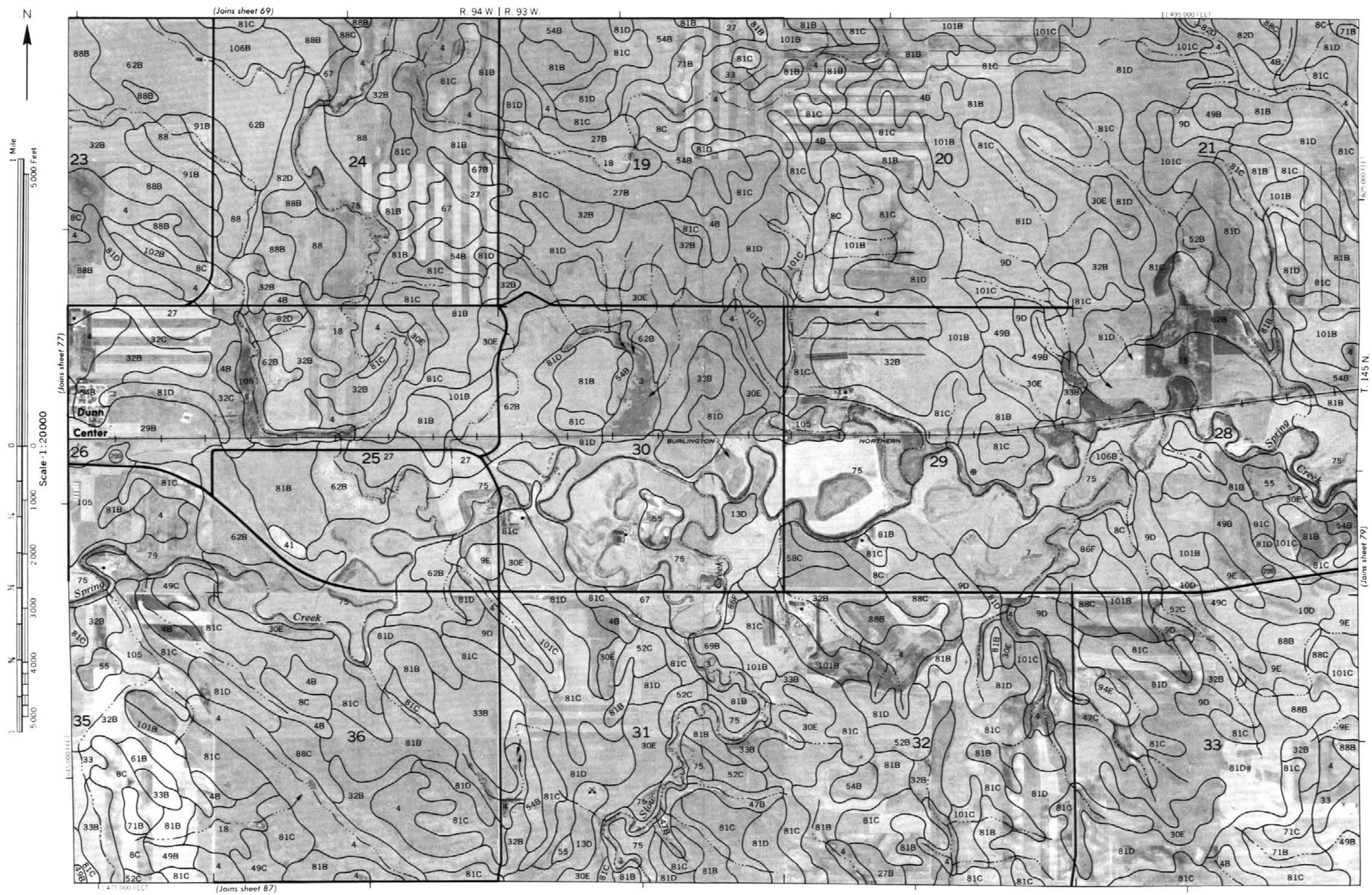
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DUNN COUNTY, NORTH DAKOTA NO. 76

DUNN COUNTY, NORTH DAKOTA NO. 77

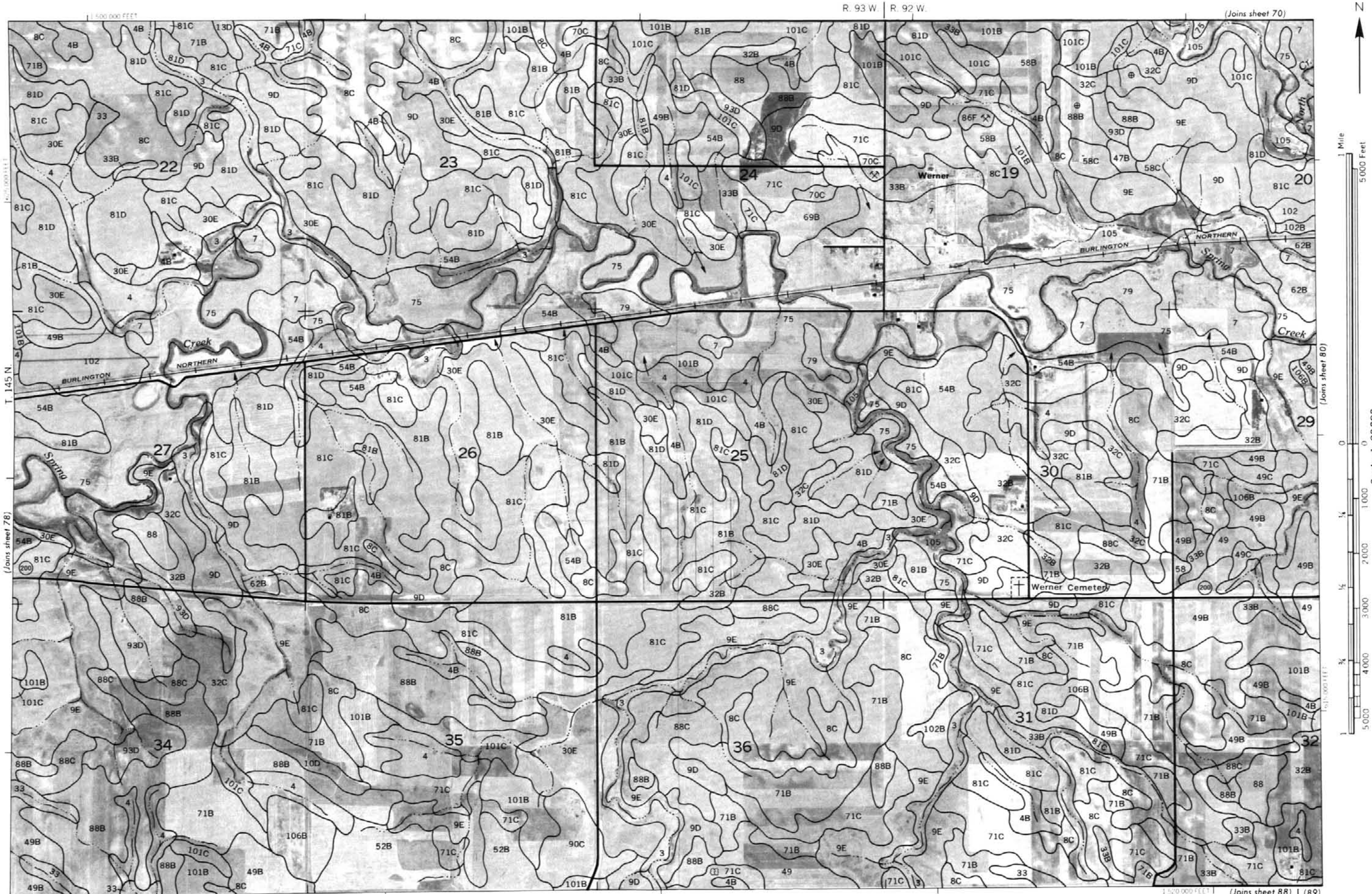
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.





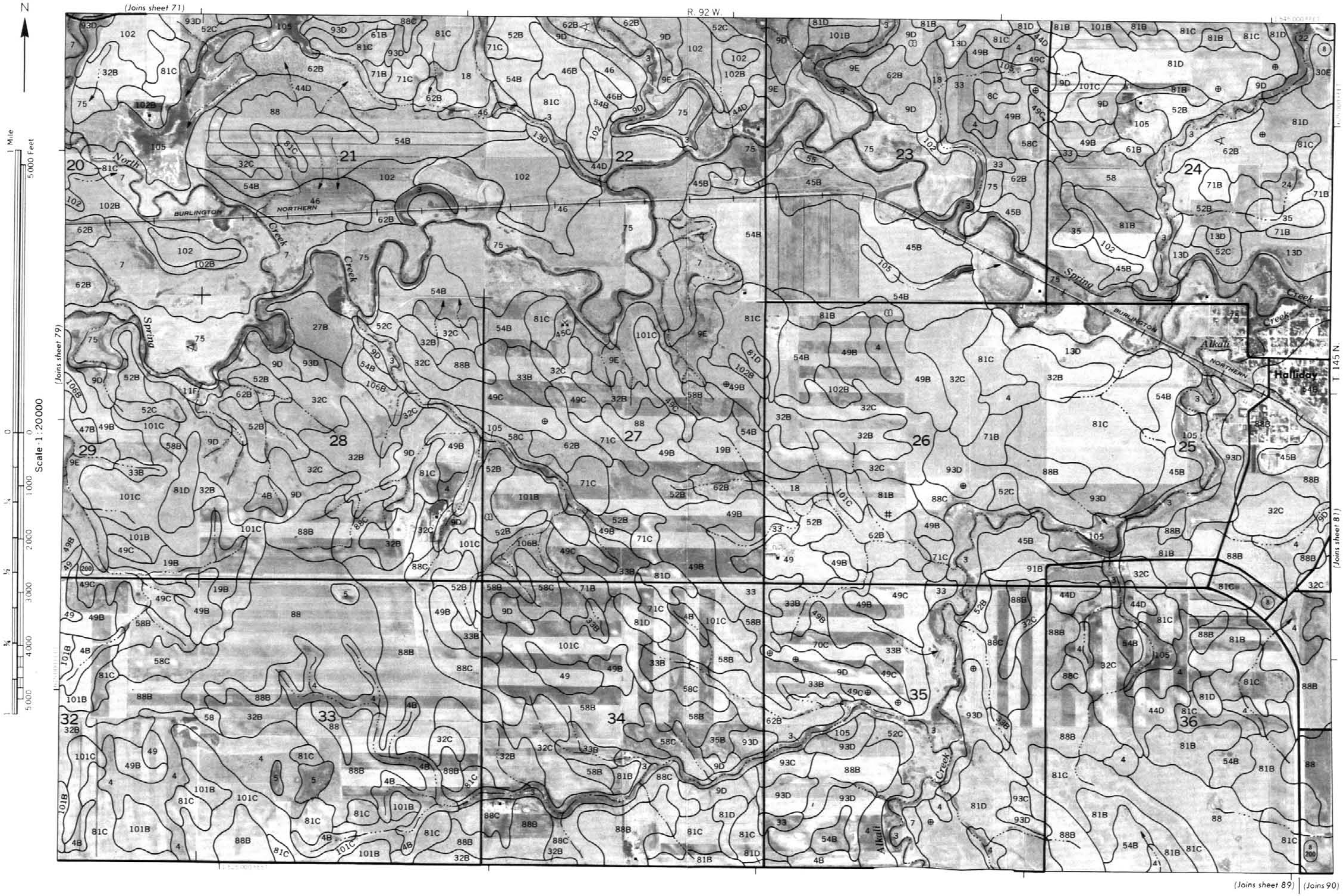
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DUNN COUNTY, NORTH DAKOTA NO. 78



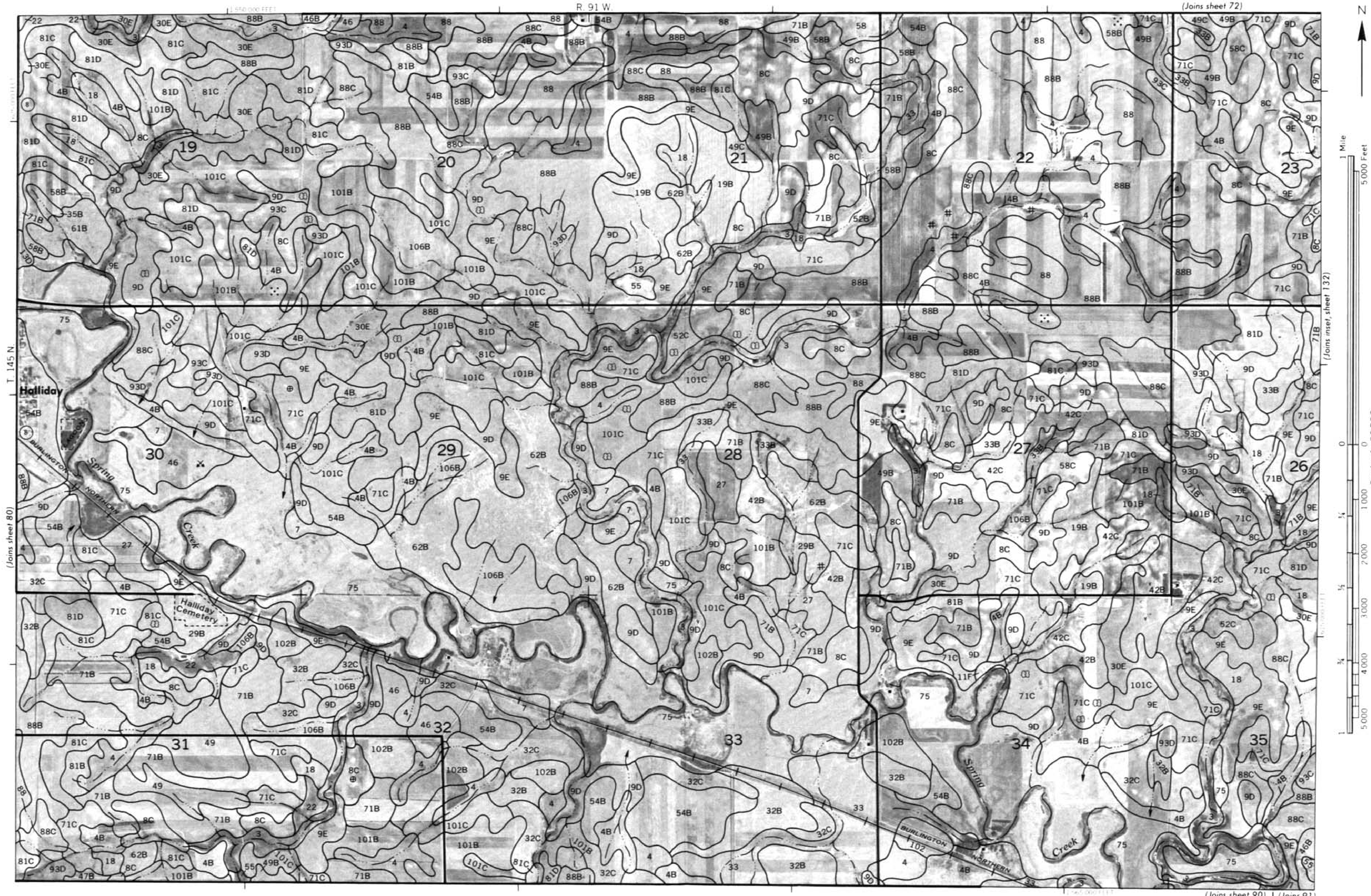
DUNN COUNTY, NORTH DAKOTA NO. 79

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



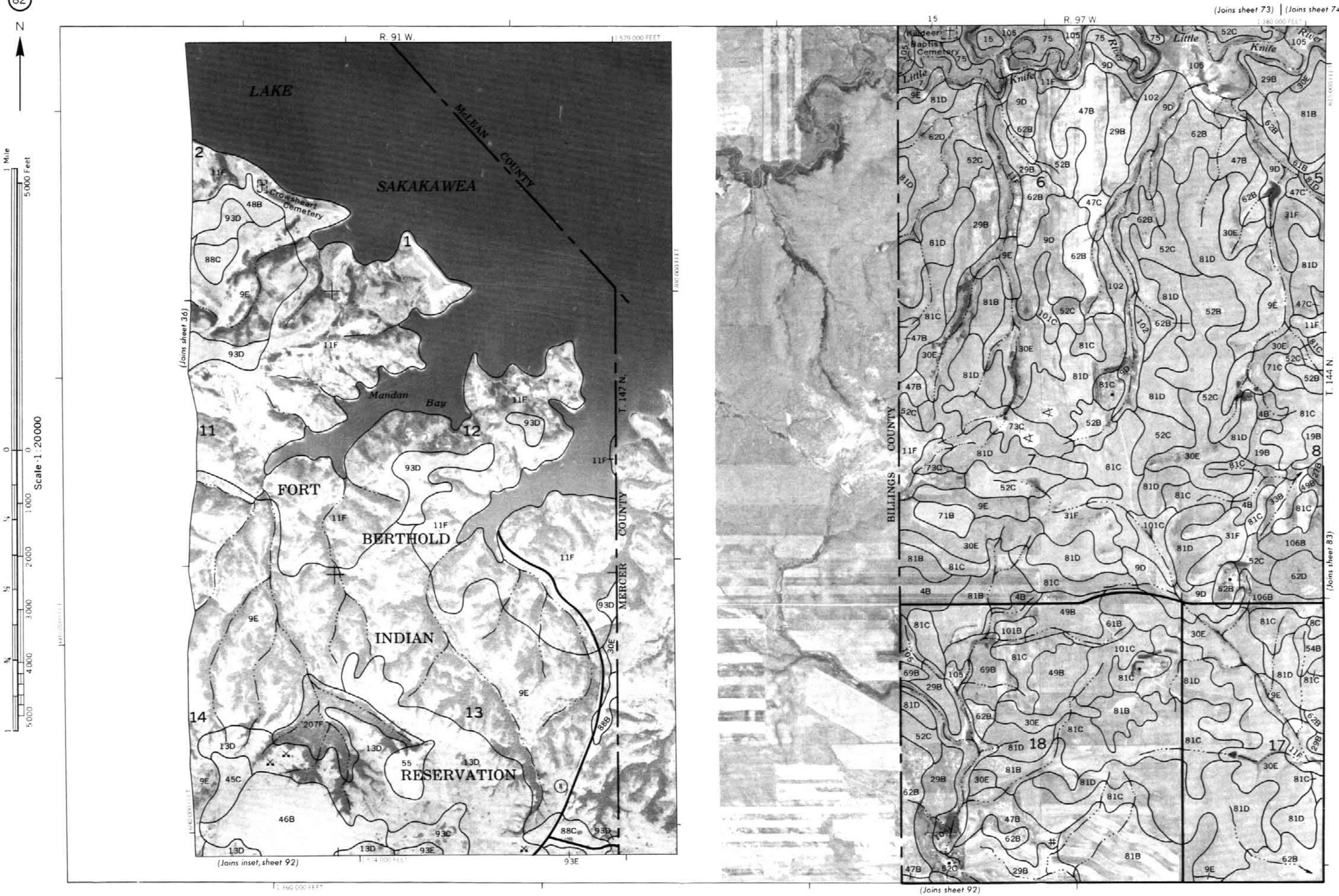
This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

81

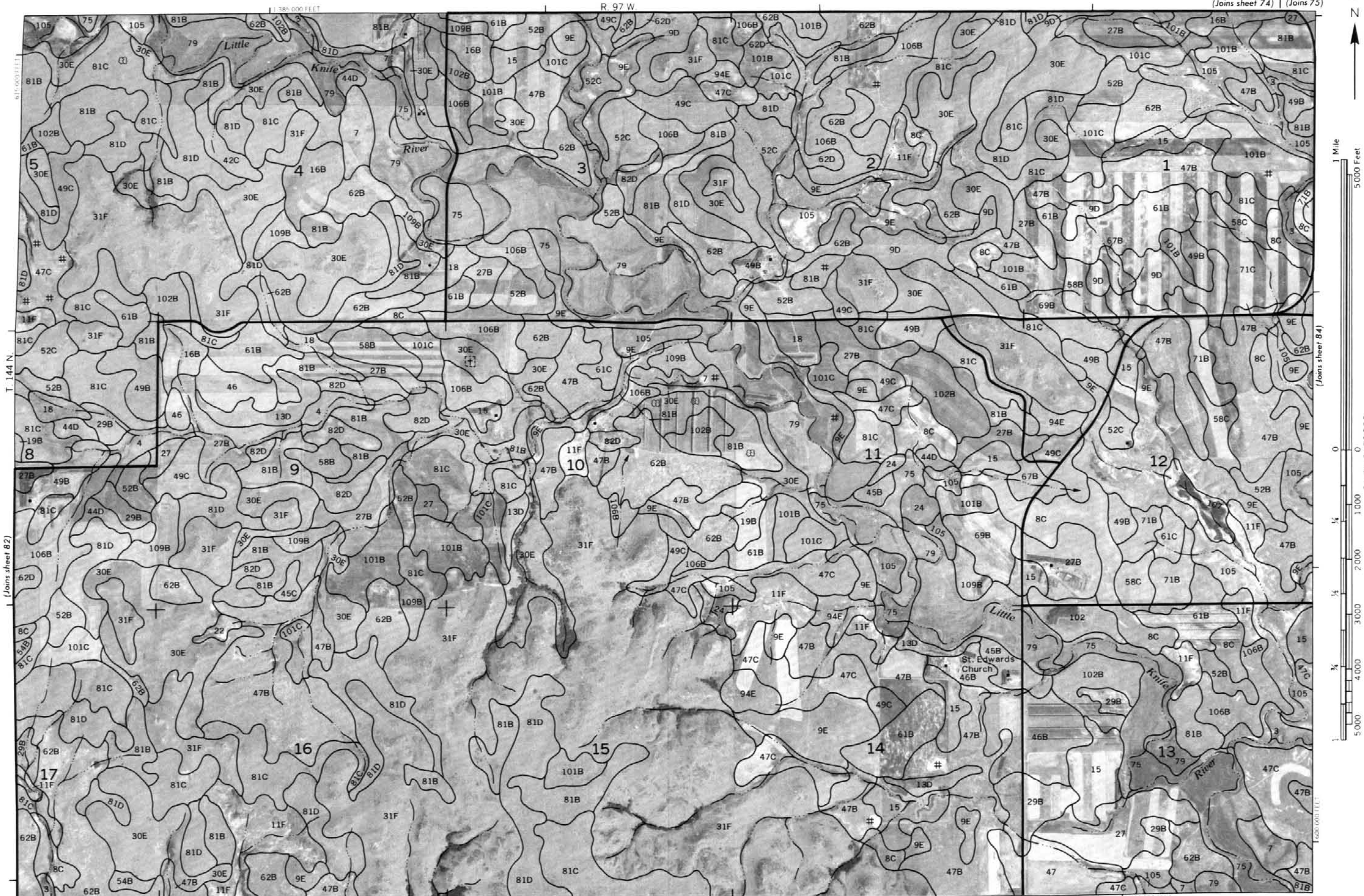


DUNN COUNTY, NORTH DAKOTA NO. 81

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

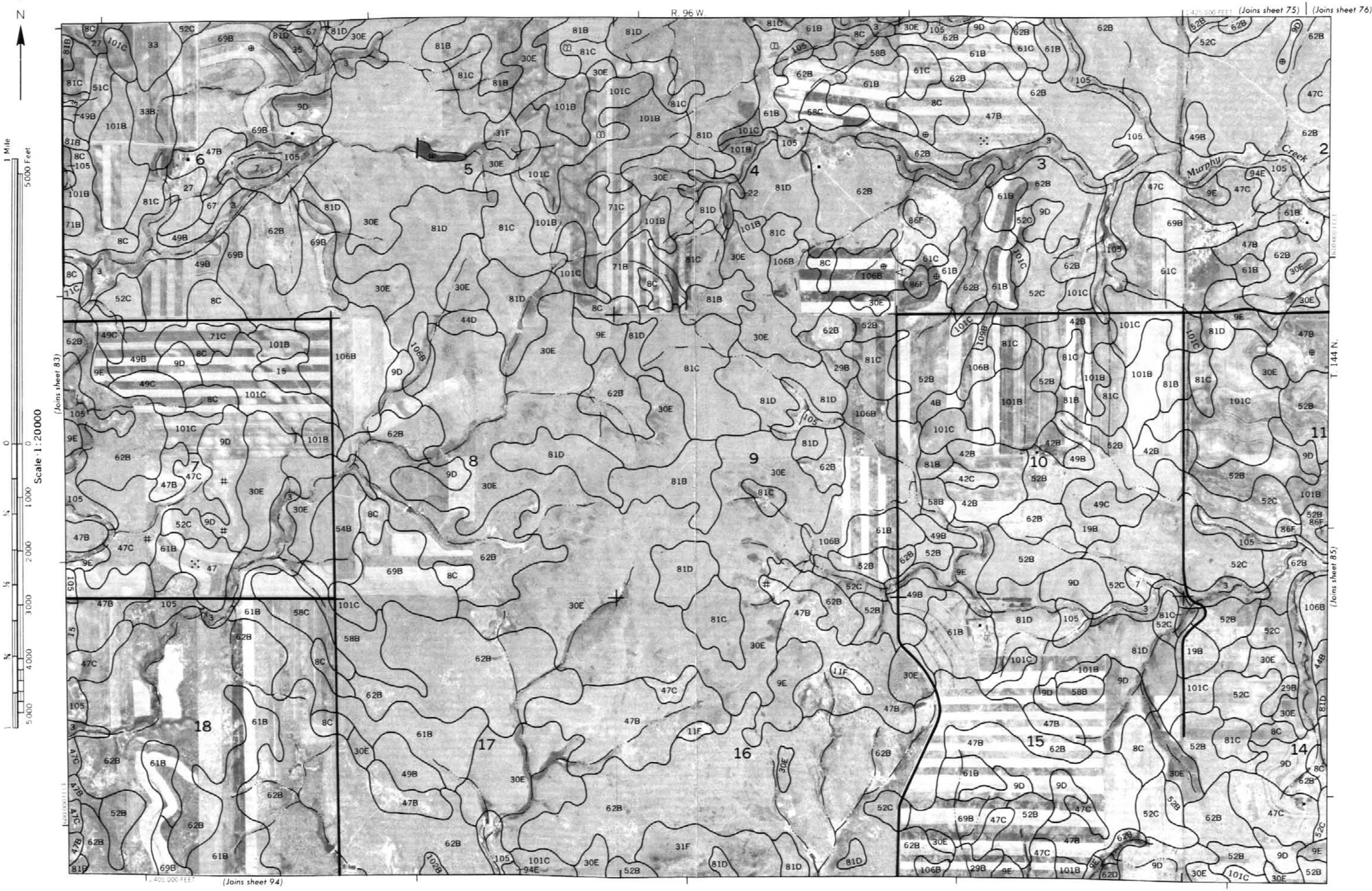


This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



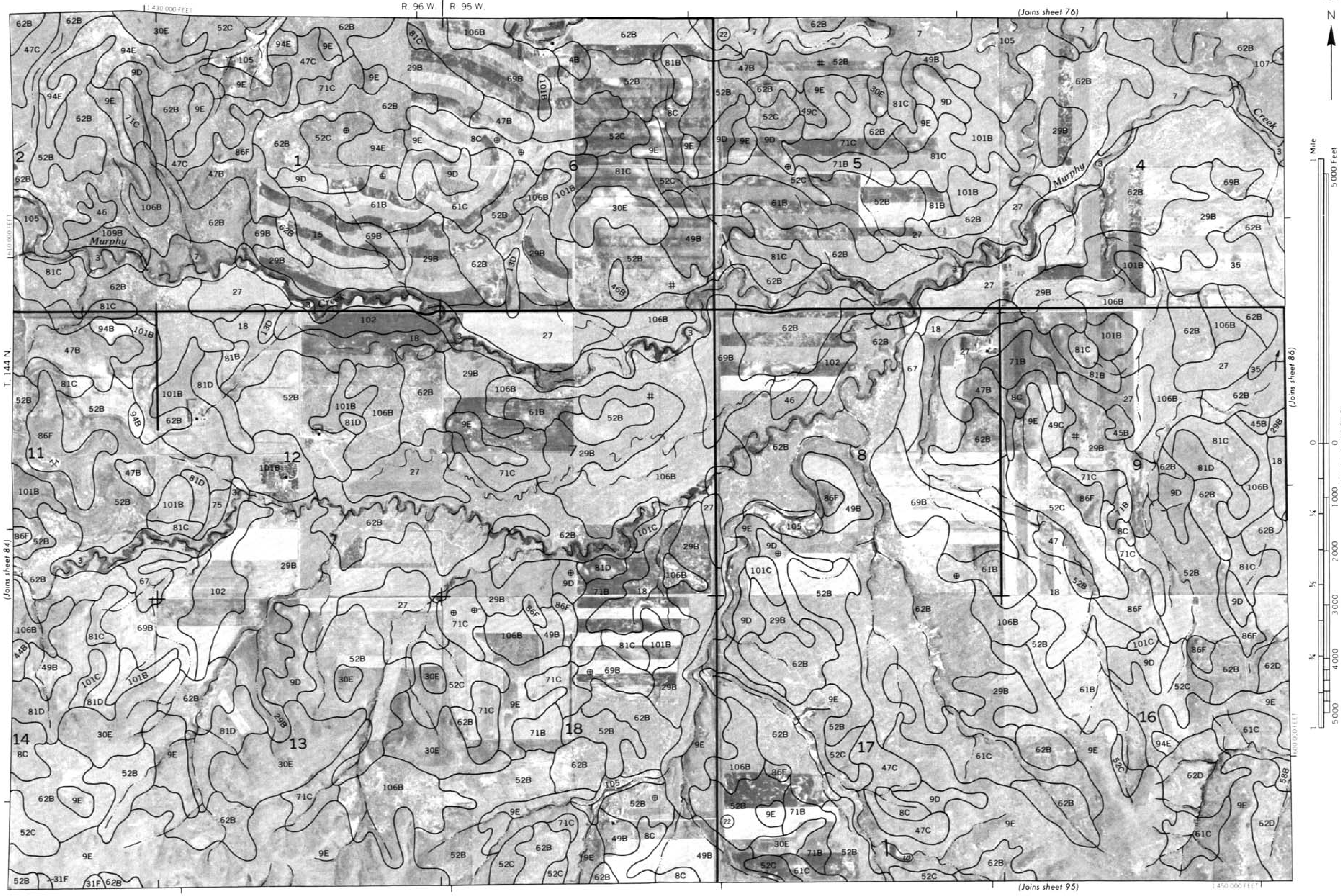
DUNN COUNTY, NORTH DAKOTA NO. 83

This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DUNN COUNTY, NORTH DAKOTA NO. 84



DUNN COUNTY, NORTH DAKOTA NO. 85

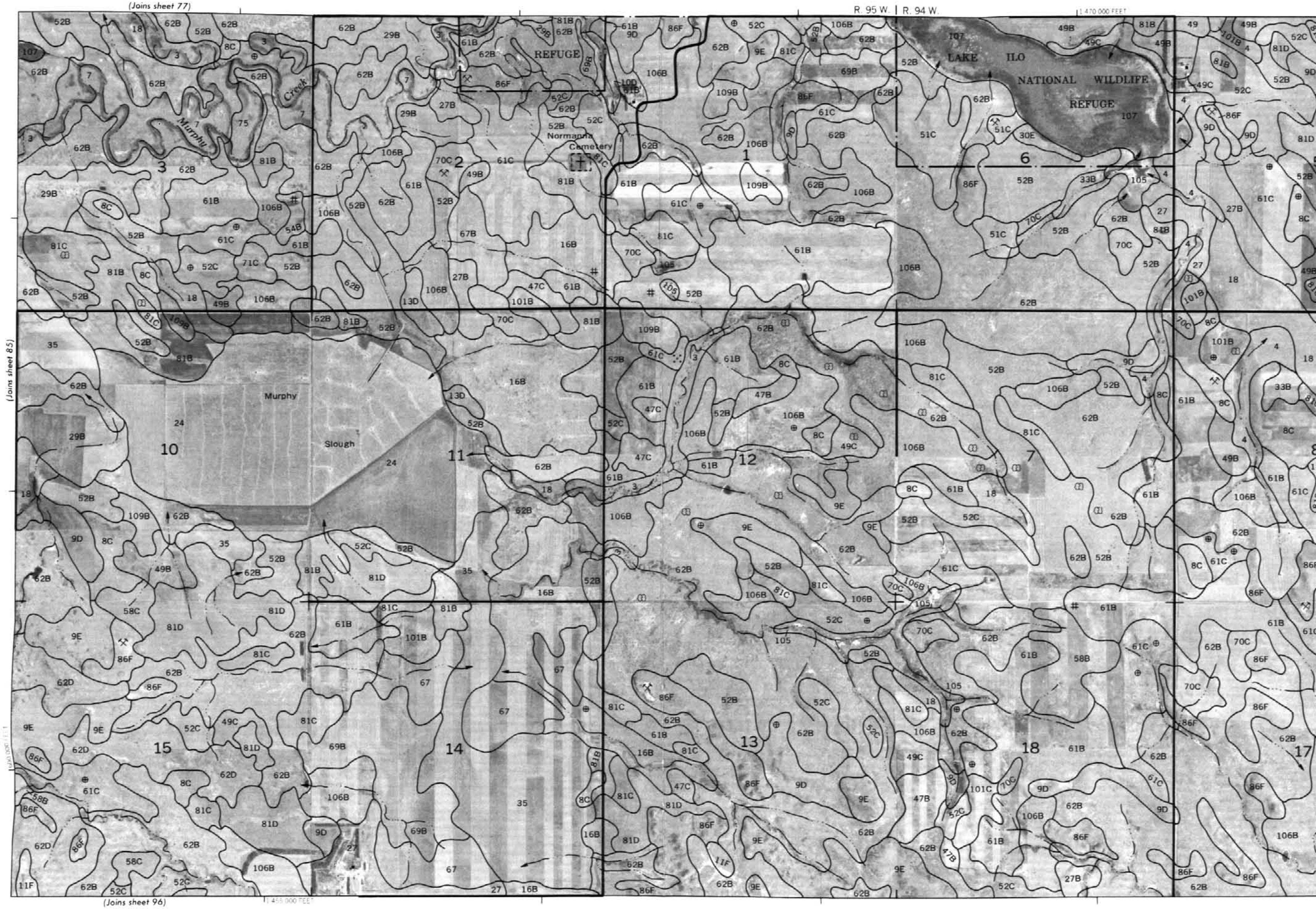
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

N

1 Mile

5000 Feet

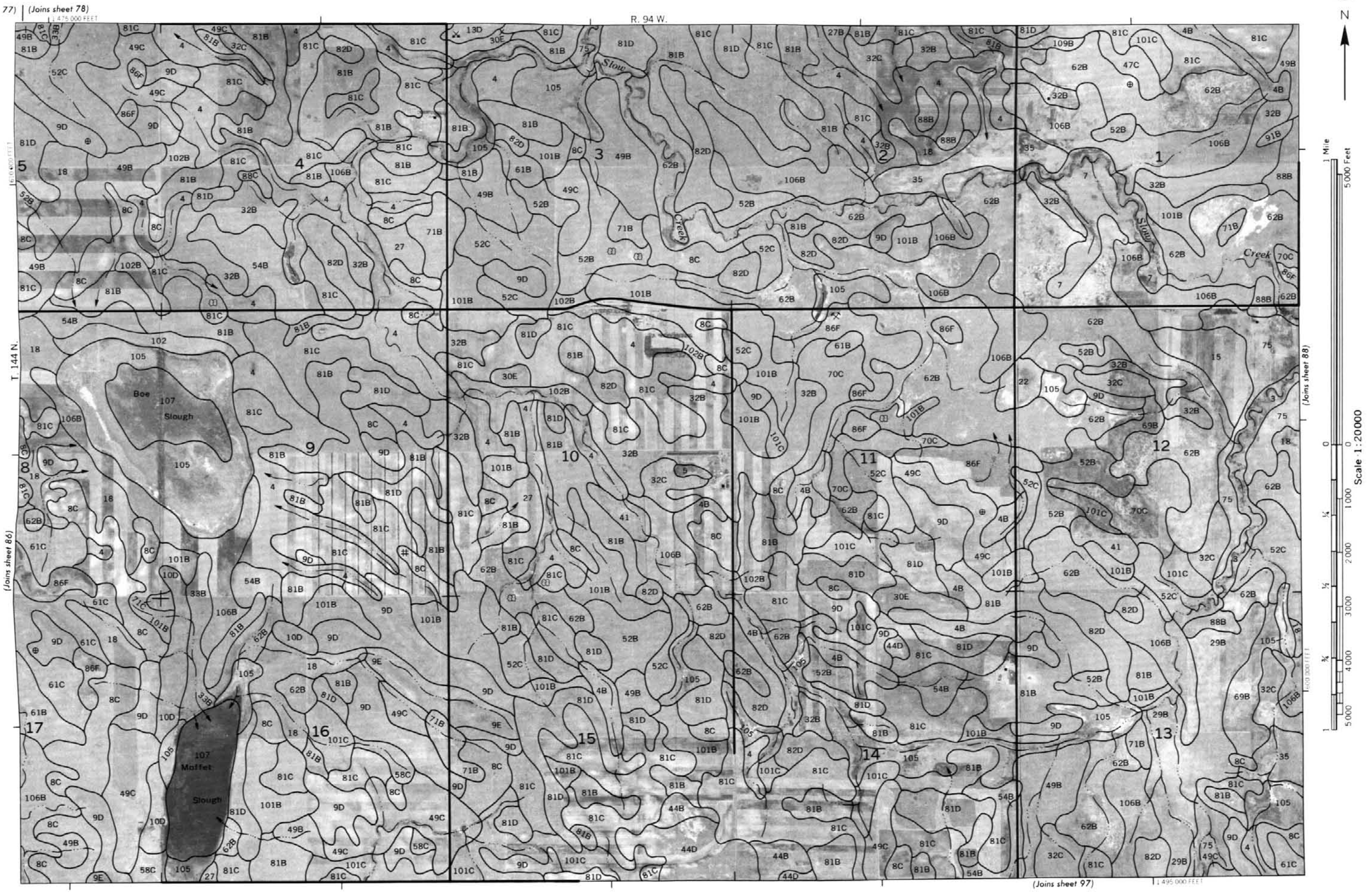
Scale 1:20000

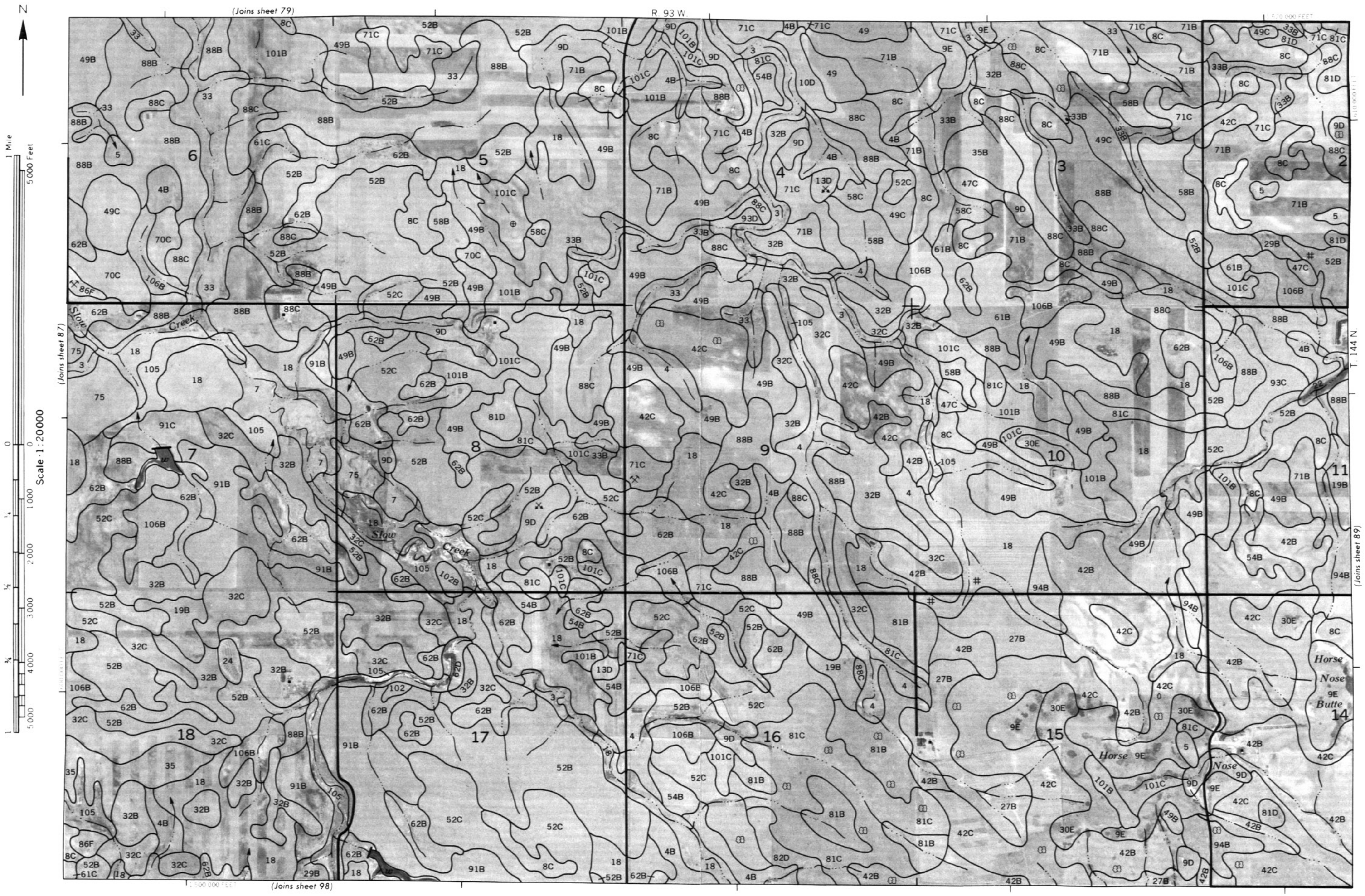


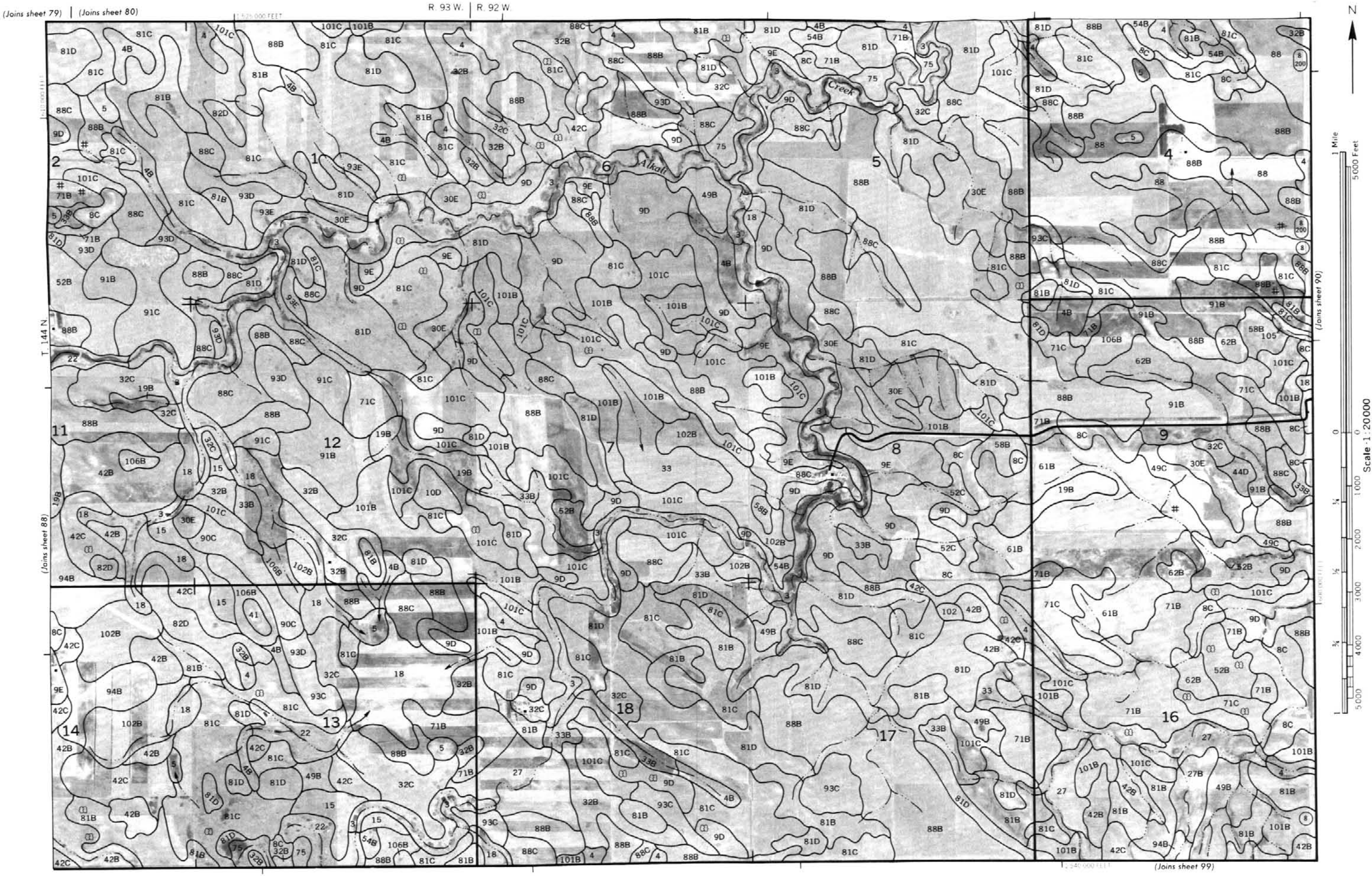
This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DUNN COUNTY, NORTH DAKOTA NO. 86

87

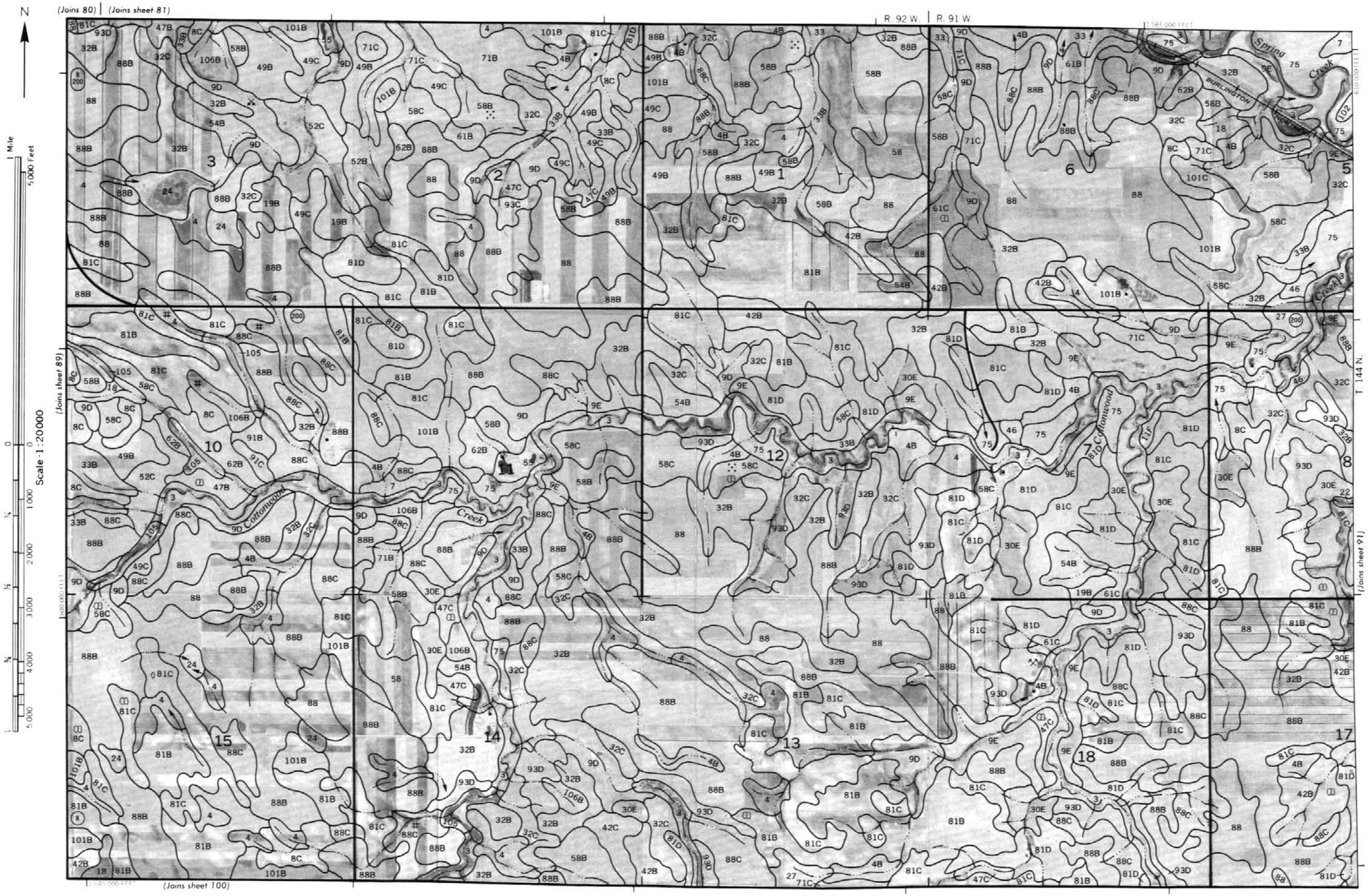

(Joins 77)
(Joins sheet 78)
R. 94 W.
T. 144 N.
(Joins sheet 86)
(Joins sheet 88)
(Joins sheet 97)
Boe
107
Slough
Moffet
Slough
Slow
Creek
N
1 Mile
5 000 Feet
Scale 1:20000
DUNN COUNTY, NORTH DAKOTA NO. 87
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.


N
Scale 1:20000
1 Mile
5000 Feet
(Joins sheet 79)
(Joins sheet 87)
(Joins sheet 89)
(Joins sheet 98)
R. 93 W.
T. 144 N.
Slow Creek
Slow Creek
Horse Nose Butte
Horse Nose

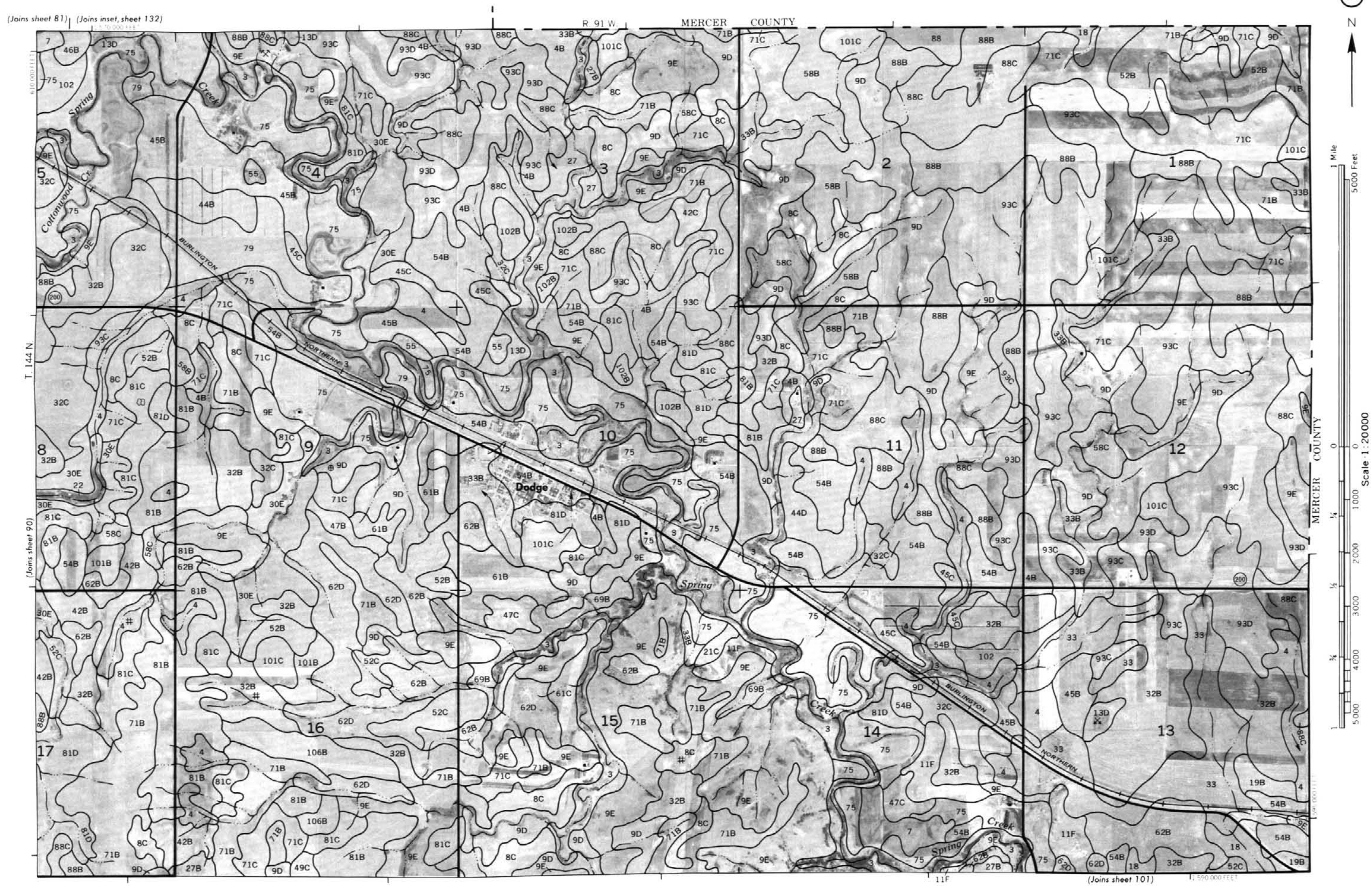


DUNN COUNTY, NORTH DAKOTA NO. 89

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

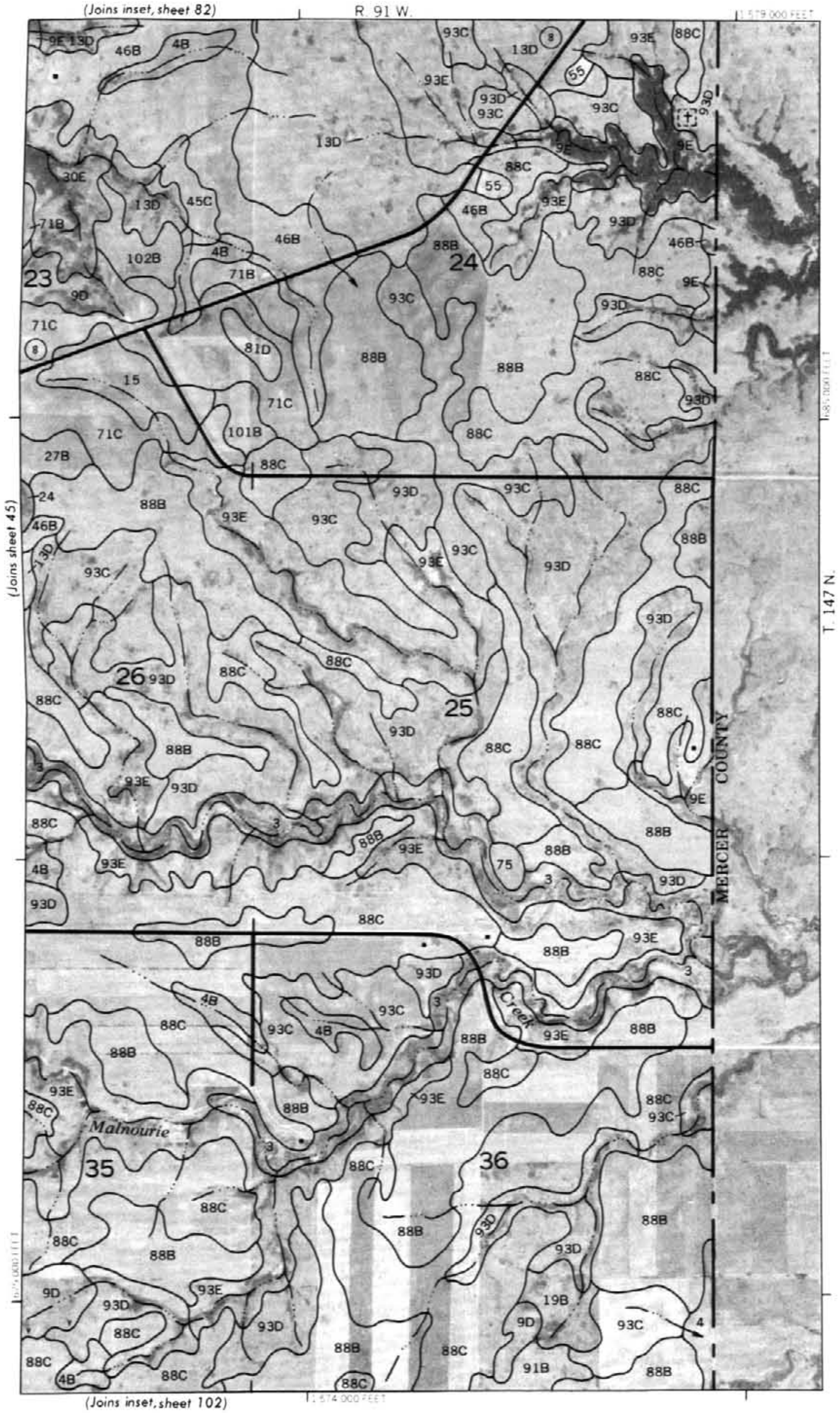


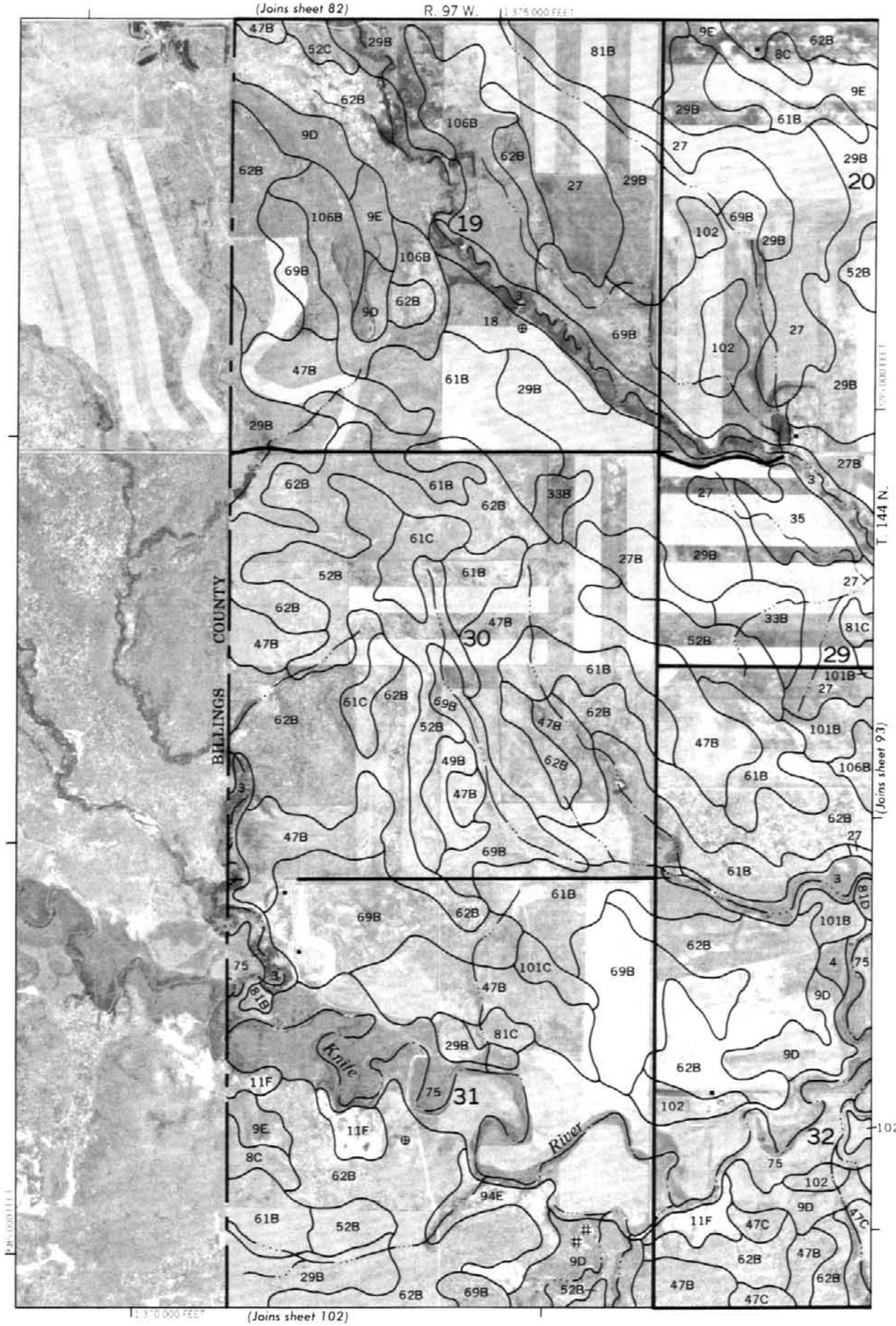
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.


91
N
(Joins sheet 81)
(Joins inset, sheet 132)
R. 91 W.
MERCER COUNTY
T. 144 N
(Joins sheet 90)
(Joins sheet 101)
MERCER COUNTY
Dodge
Spring Creek
Cottonwood Cr.
Spring
Creek
BURLINGTON
NORTHERN
200
1 Mile
5000 Feet
Scale 1:20000
0
¼
½
¾
1
0
1000
2000
3000
4000
5000
DUNN COUNTY, NORTH DAKOTA NO. 91
This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

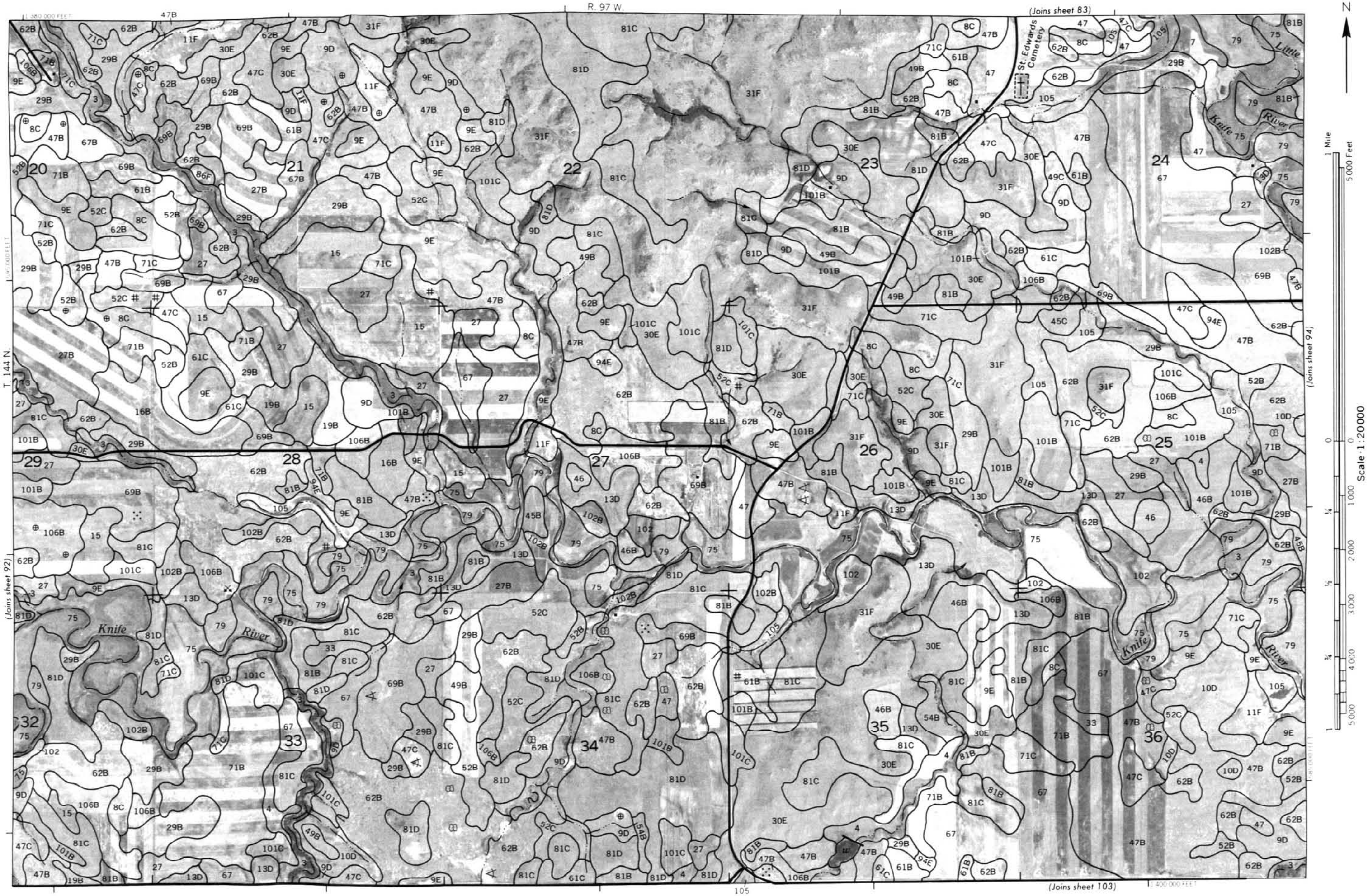
N

1 Mile
5 000 Feet
0
0
Scale 1:20000
1000
2000
3000
4000
5000
1
5000





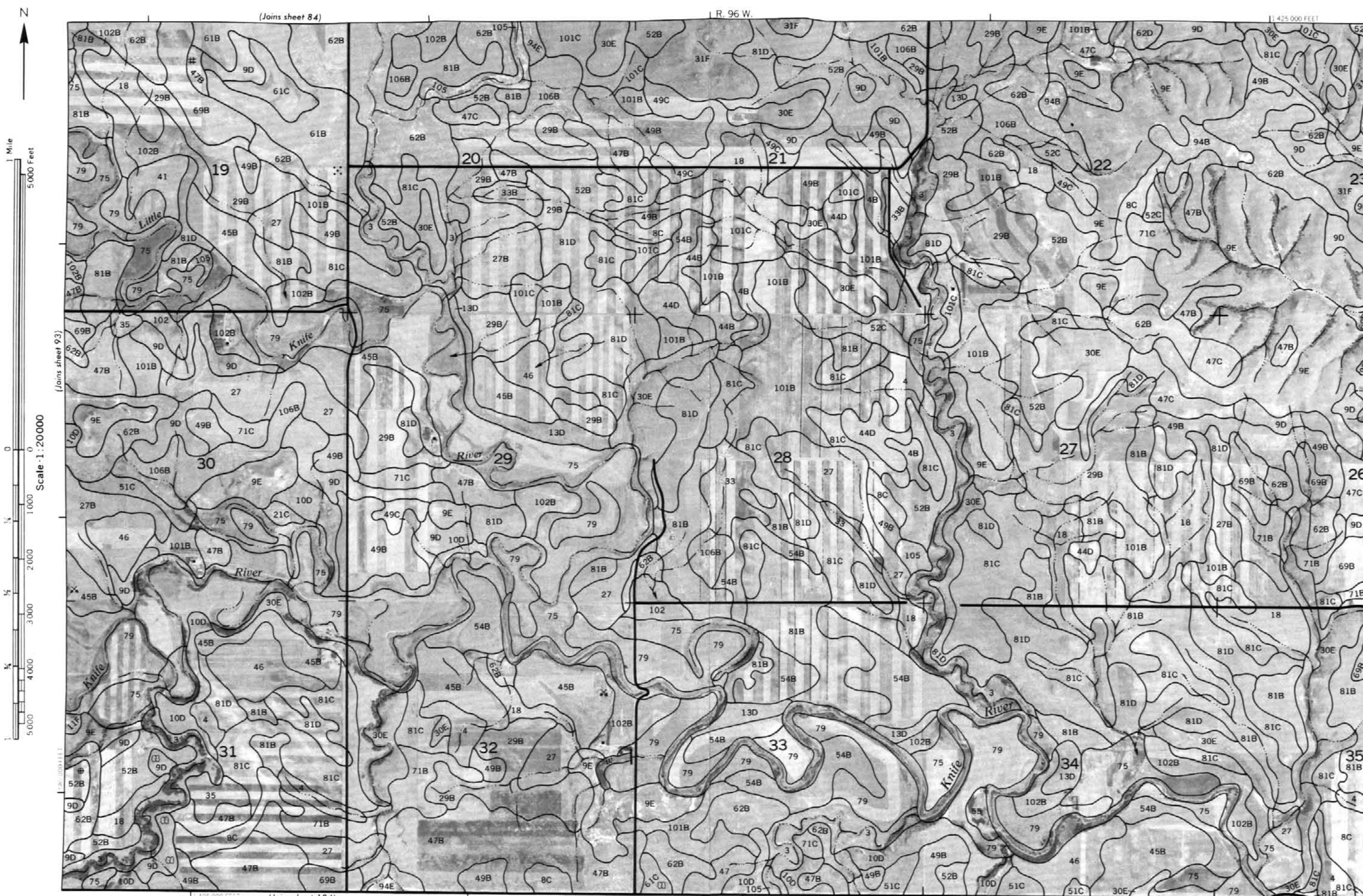
DUNN COUNTY, NORTH DAKOTA NO. 92



DUNN COUNTY, NORTH DAKOTA NO. 93

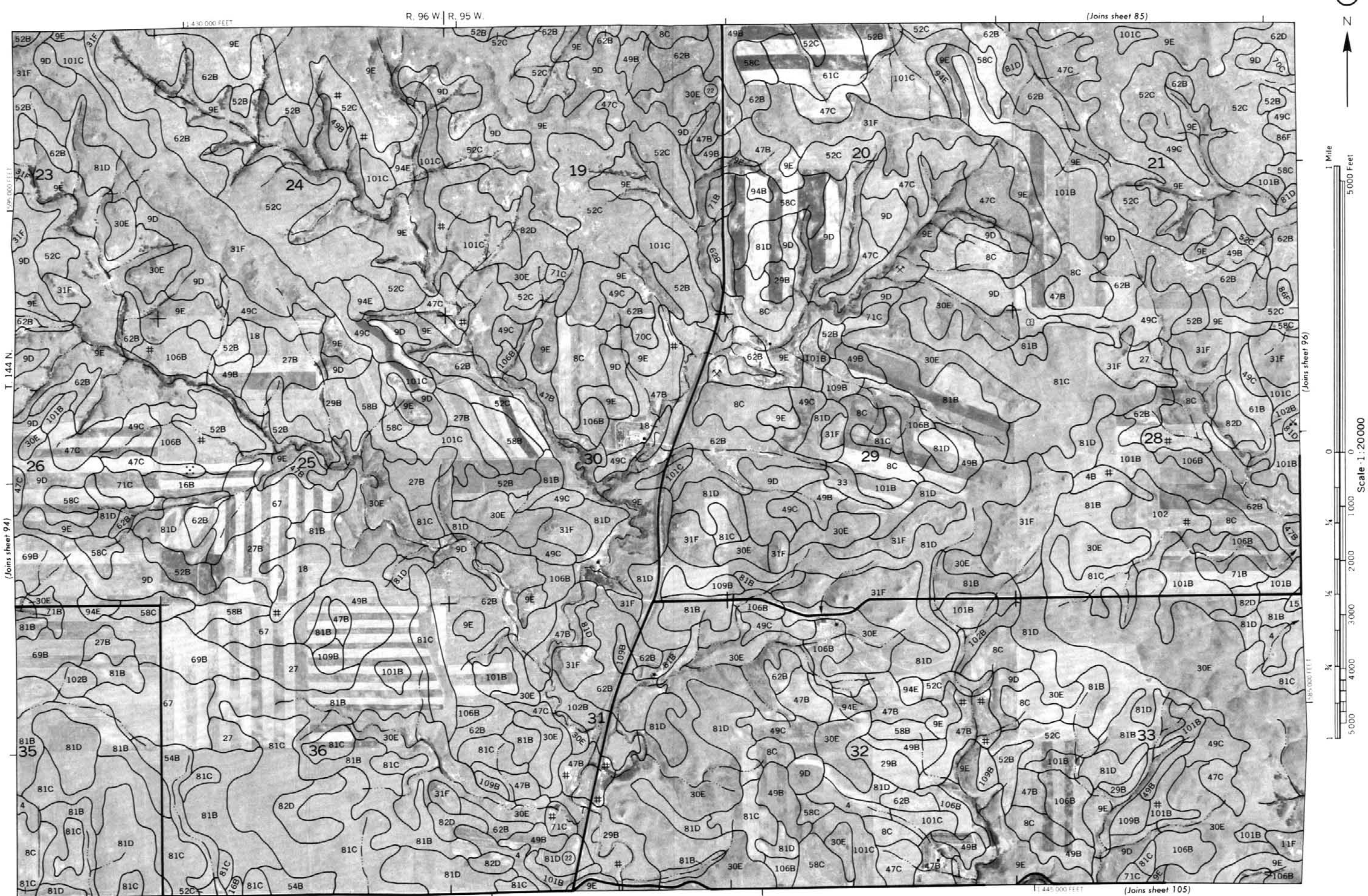
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DUNN COUNTY, NORTH DAKOTA — SHEET NUMBER 94



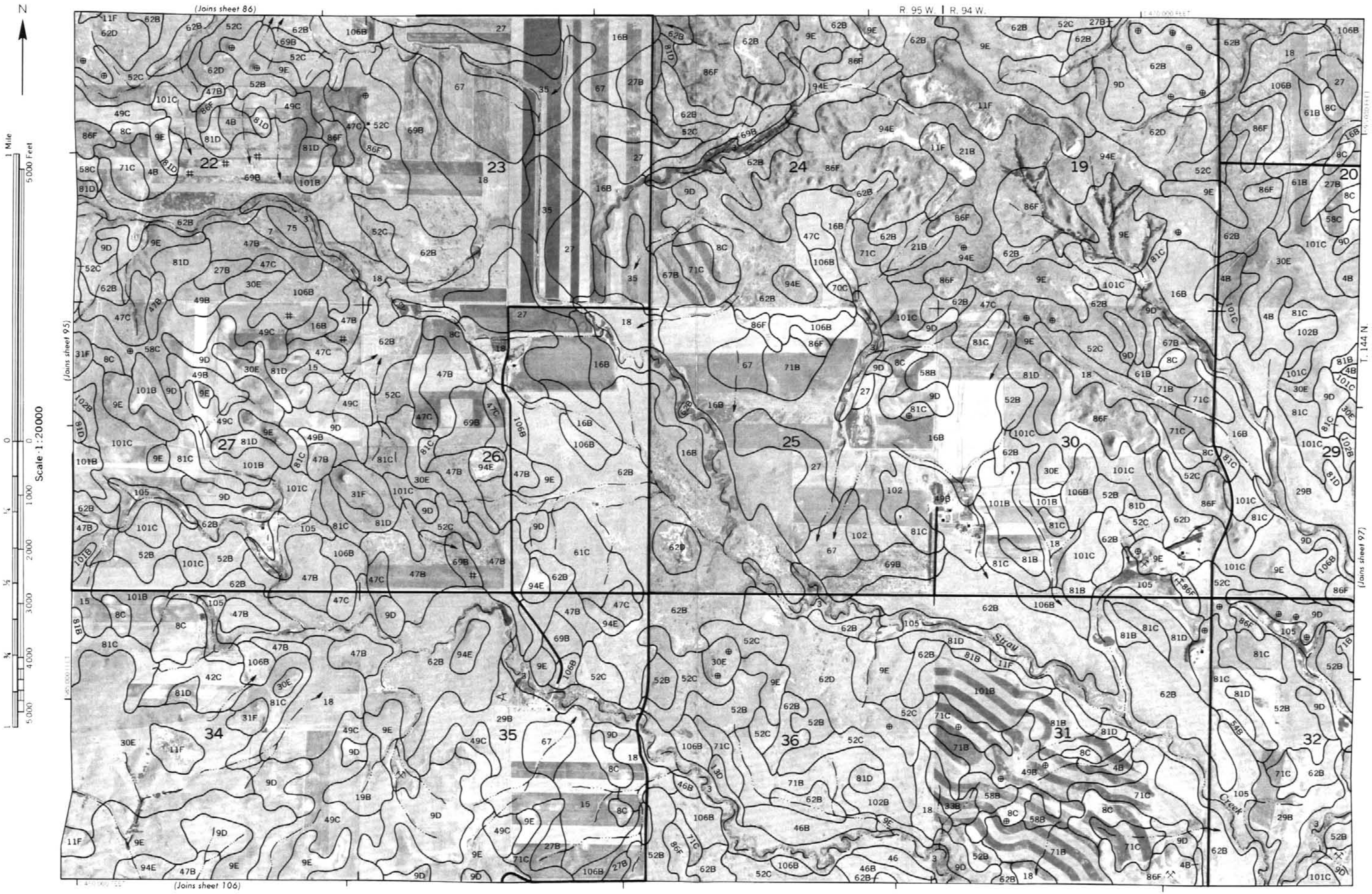
This map is compiled on 1974 aerial photographs by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

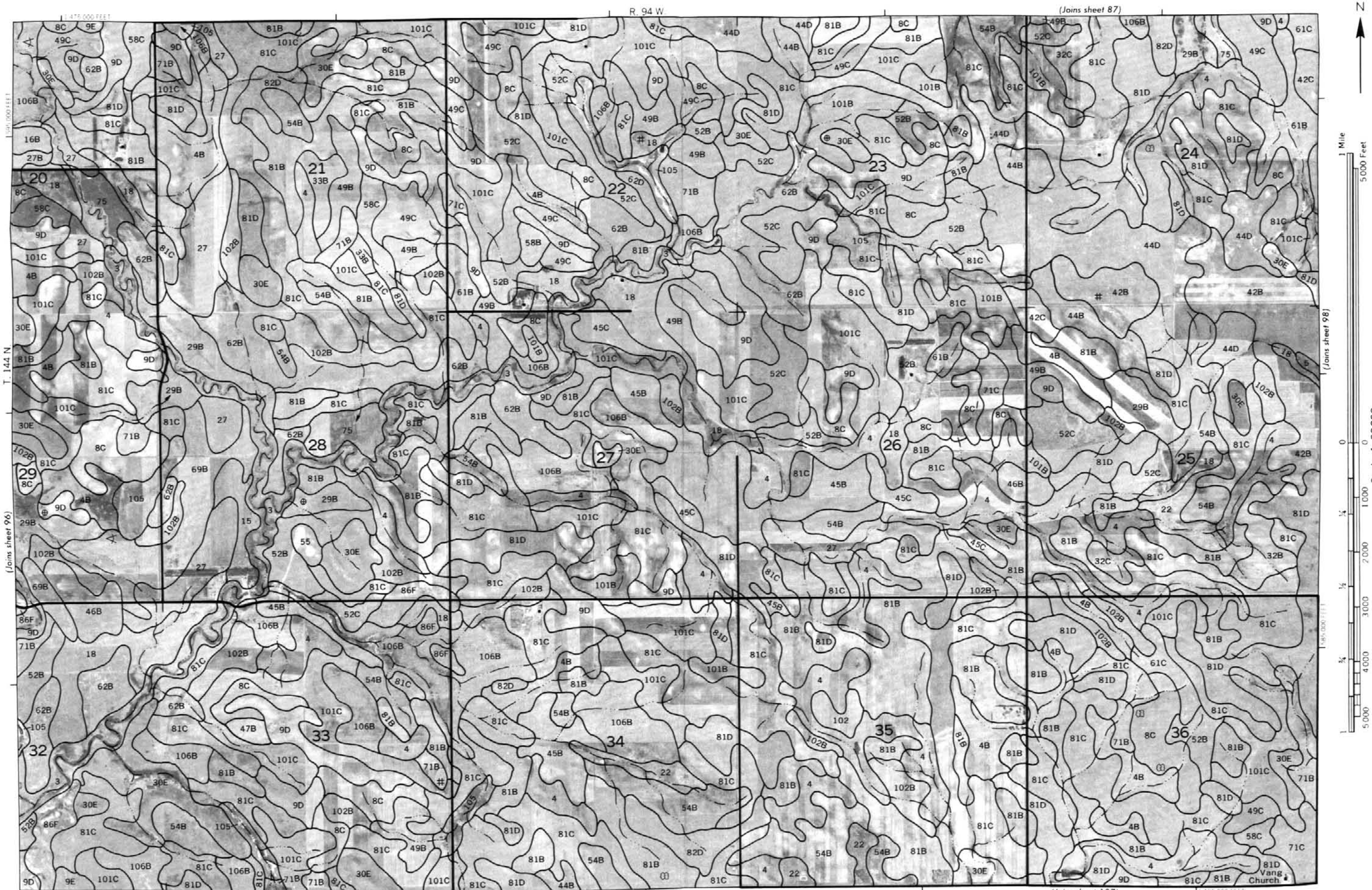
DUNN COUNTY, NORTH DAKOTA NO. 94



DUNN COUNTY, NORTH DAKOTA NO. 95

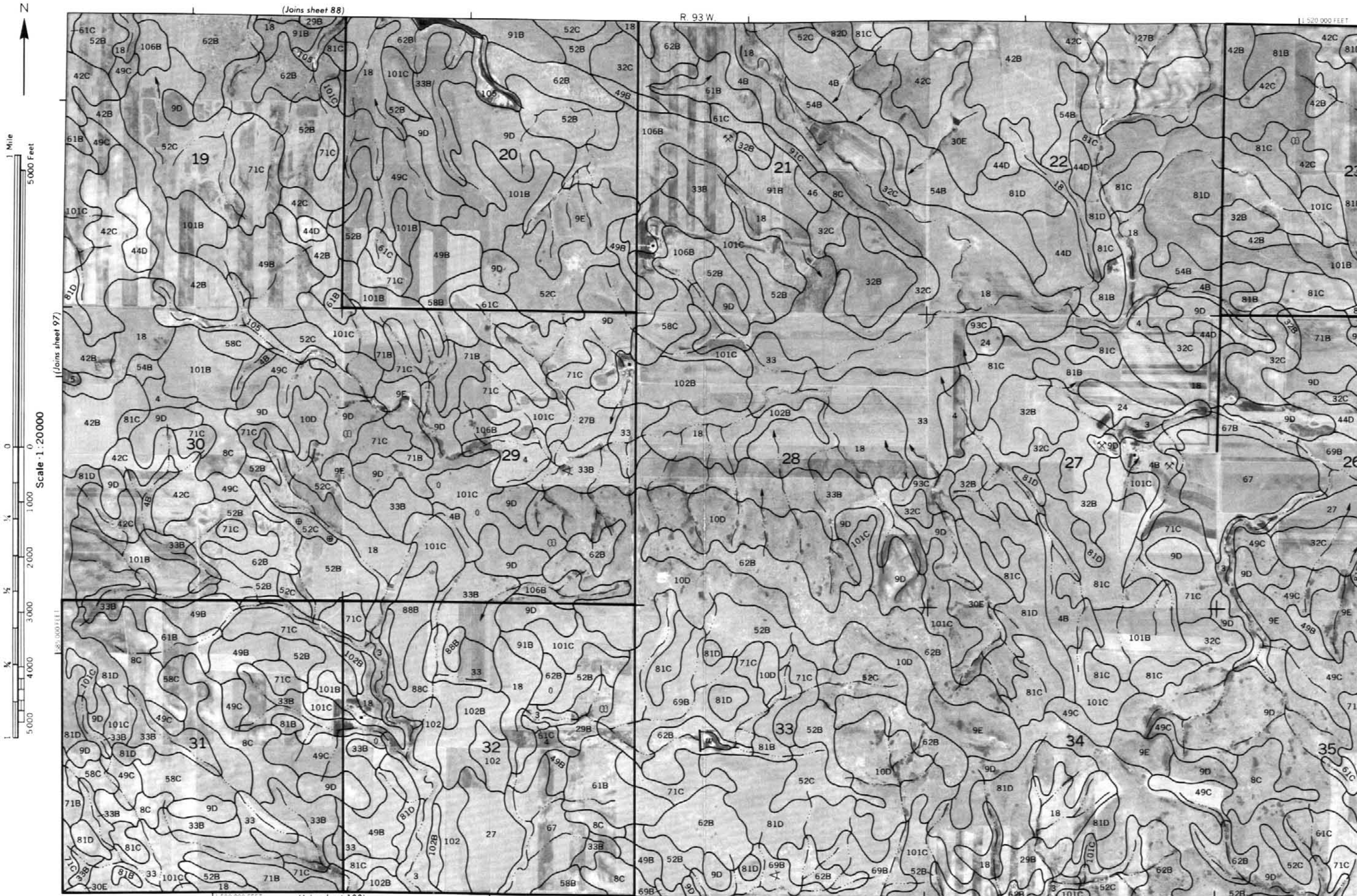
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.


(Joins sheet 86)
R. 95 W.
R. 94 W.
T. 144 N.
(Joins sheet 95)
(Joins sheet 97)
(Joins sheet 106)
N
1 Mile
5000 Feet
Scale 1:20000
22
23
24
19
20
27
26
25
30
29
34
35
36
31
32



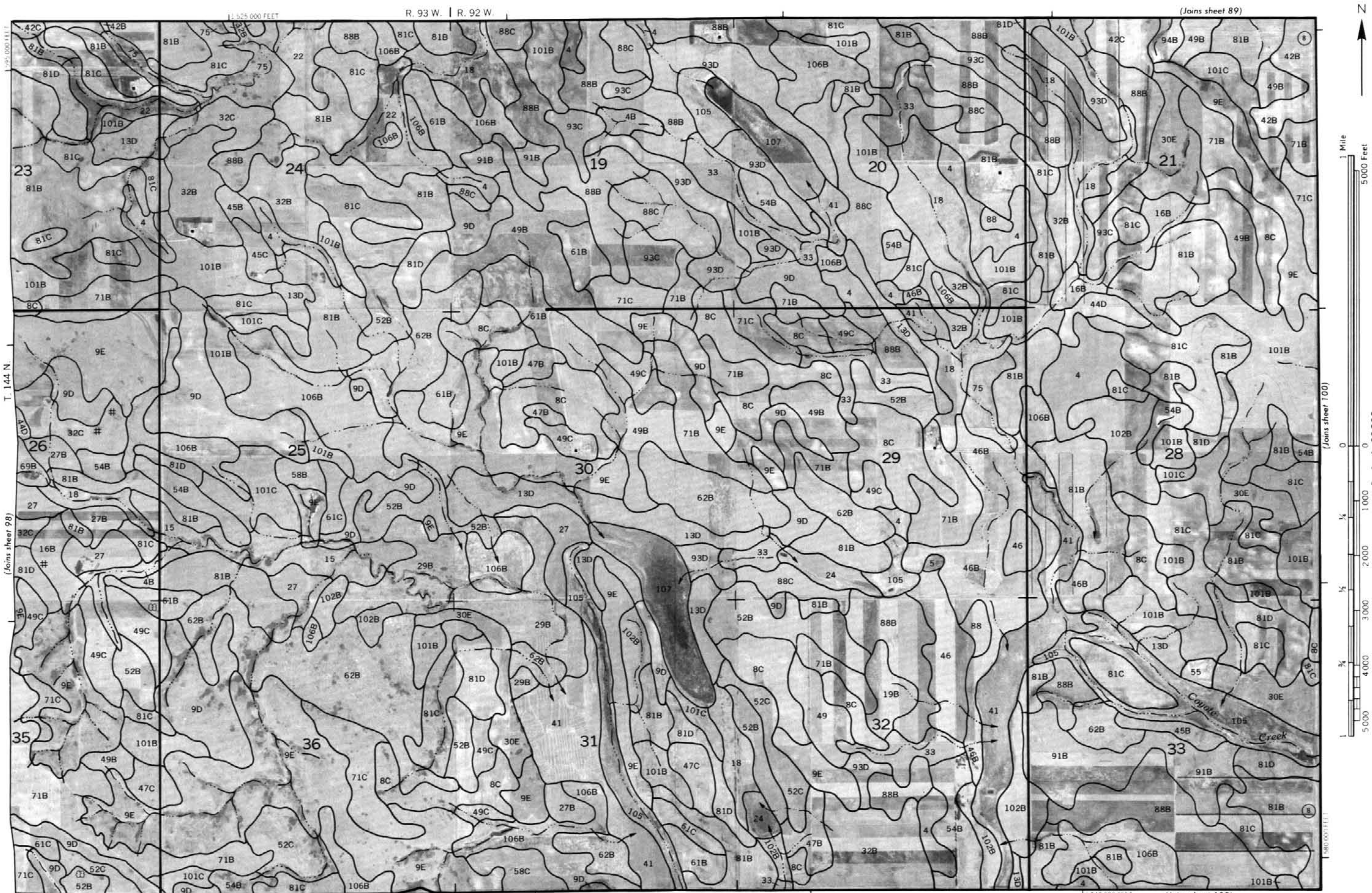
DUNN COUNTY, NORTH DAKOTA NO. 97

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



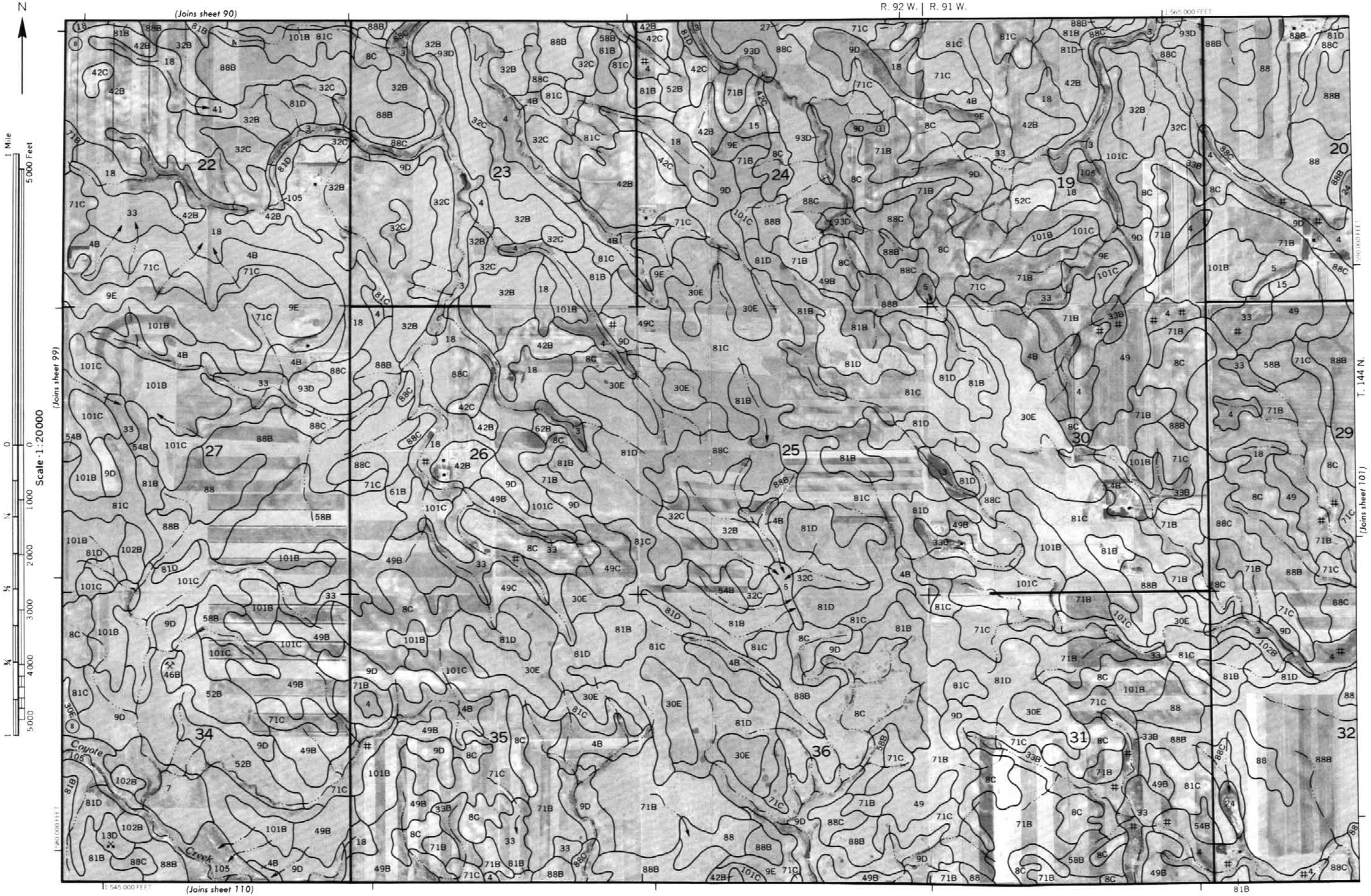
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DUNN COUNTY, NORTH DAKOTA NO. 98

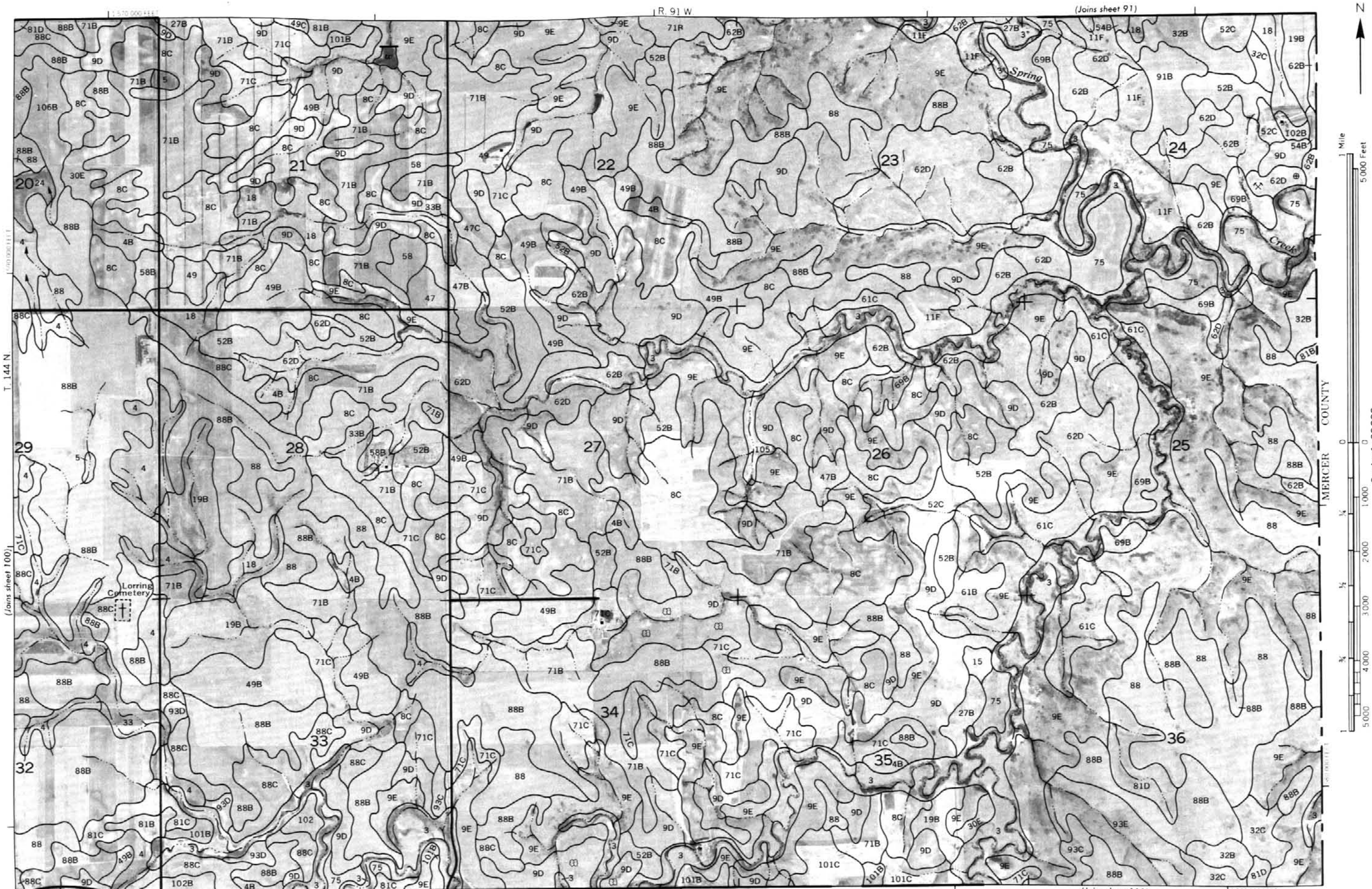


DUNN COUNTY, NORTH DAKOTA NO. 99

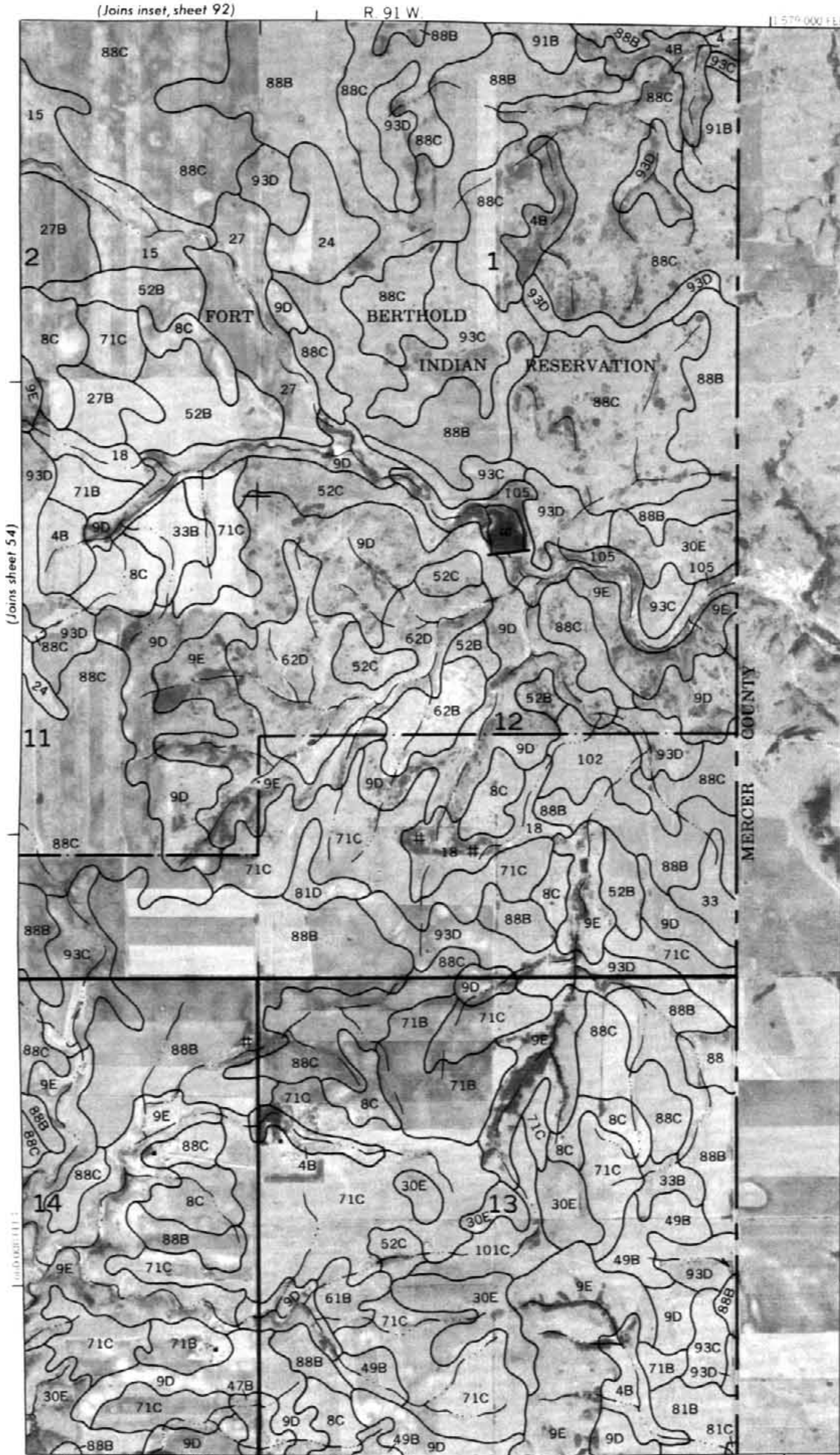
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.


N
(Joins sheet 90)
R. 92 W. | R. 91 W.
1 565 000 FEET
(Joins sheet 99)
(Joins sheet 101)
T. 144 N.
(Joins sheet 110)
1 545 000 FEET
580 000 FEET
590 000 FEET
Scale 1:20000
1 Mile
5 000 Feet
22
23
24
19
20
27
26
25
30
29
34
35
36
31
32
Coyote
Creek

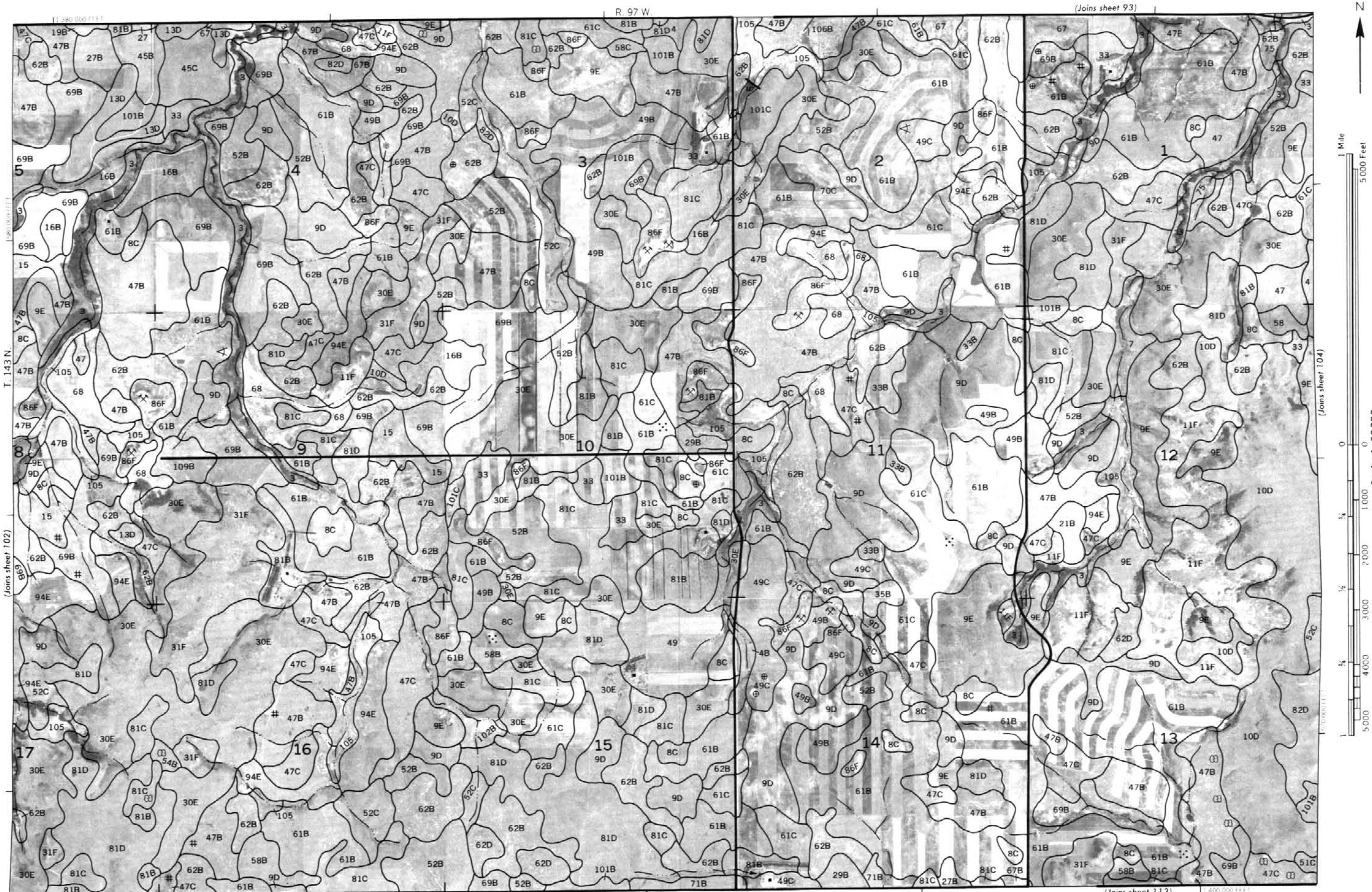
DUNN COUNTY, NORTH DAKOTA NO. 101



DUNN COUNTY, NORTH DAKOTA — SHEET NUMBER 102



This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

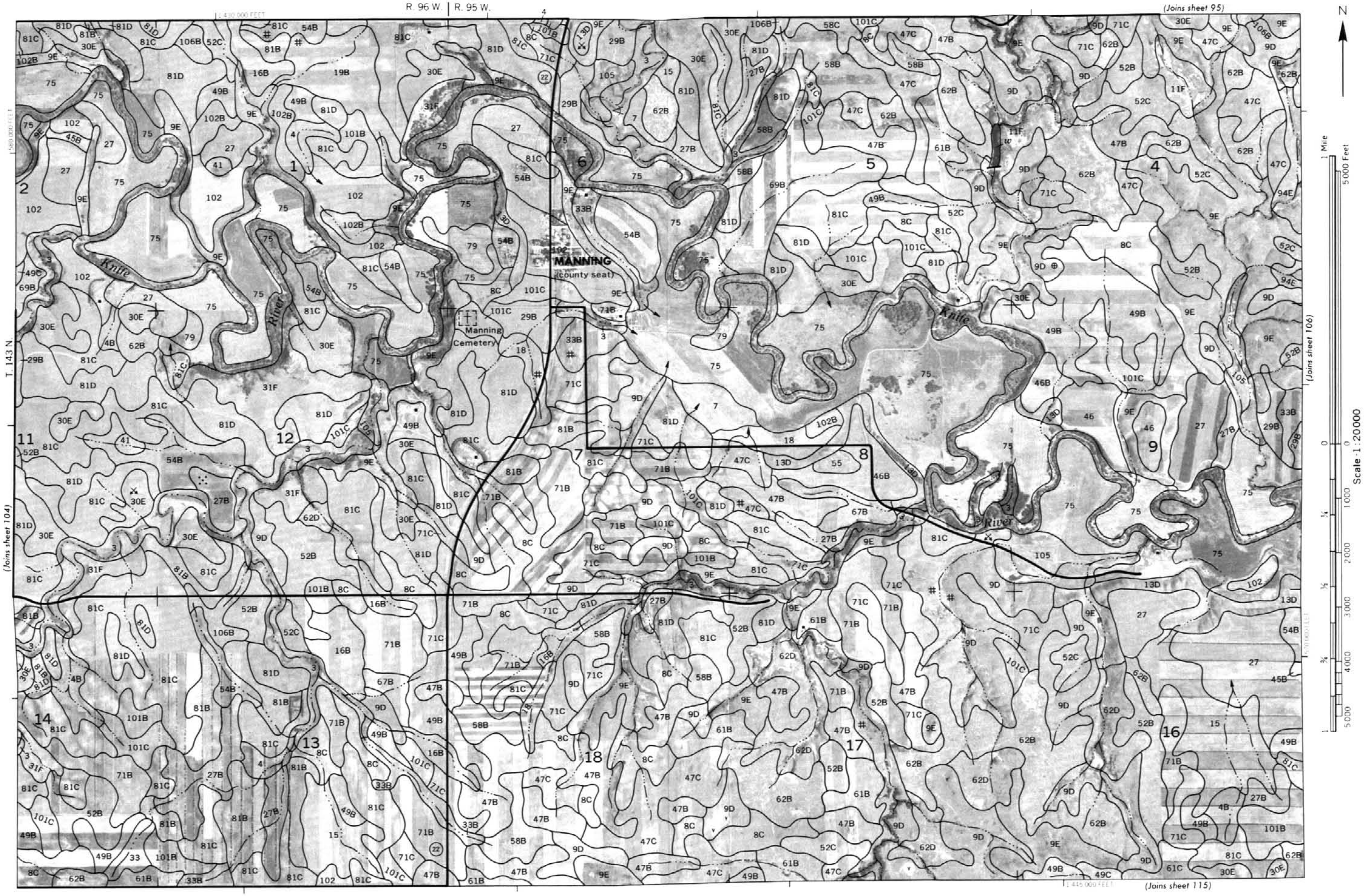


DUNN COUNTY, NORTH DAKOTA NO. 103

This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

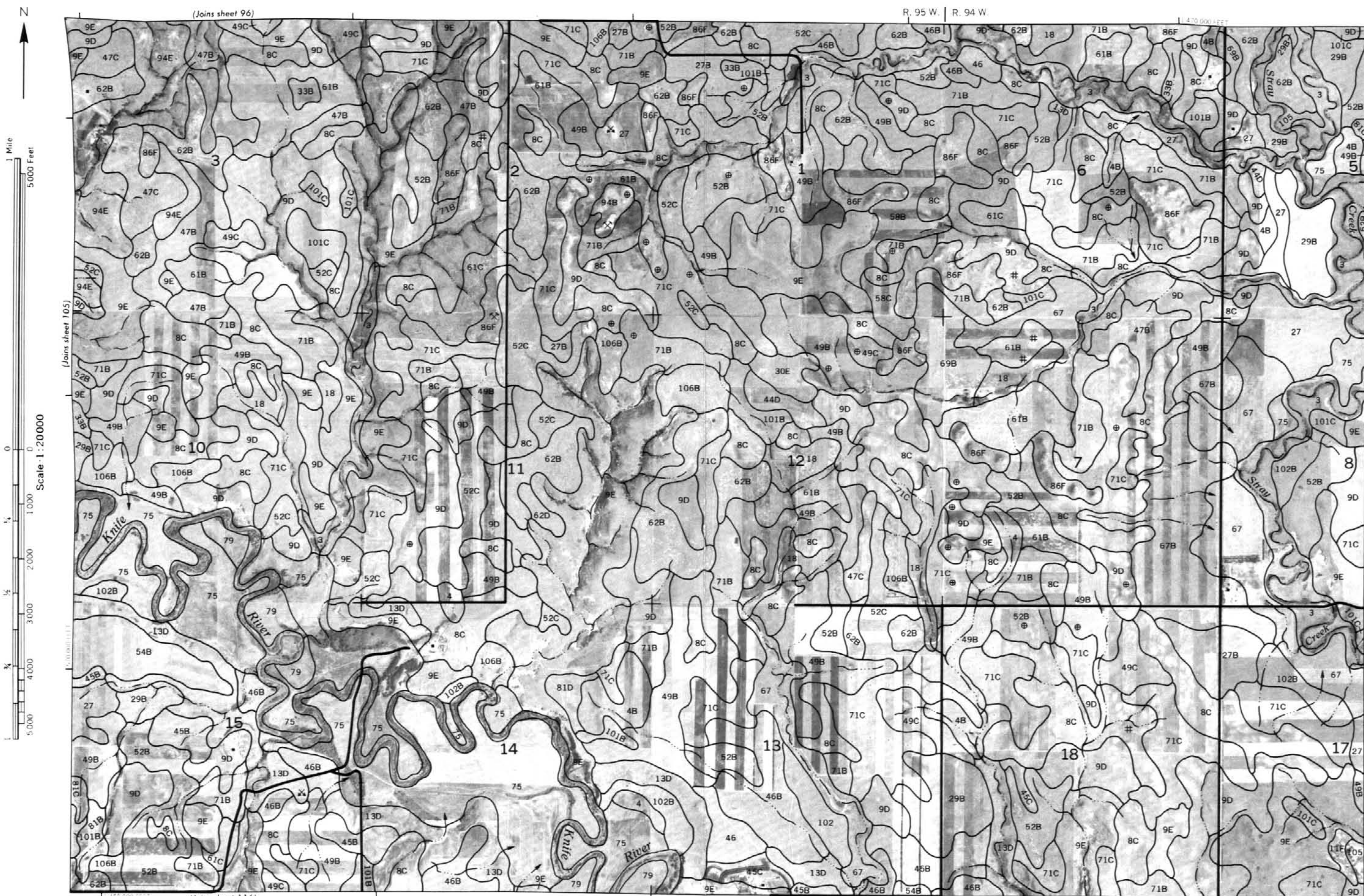
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DUNN COUNTY, NORTH DAKOTA NO. 104



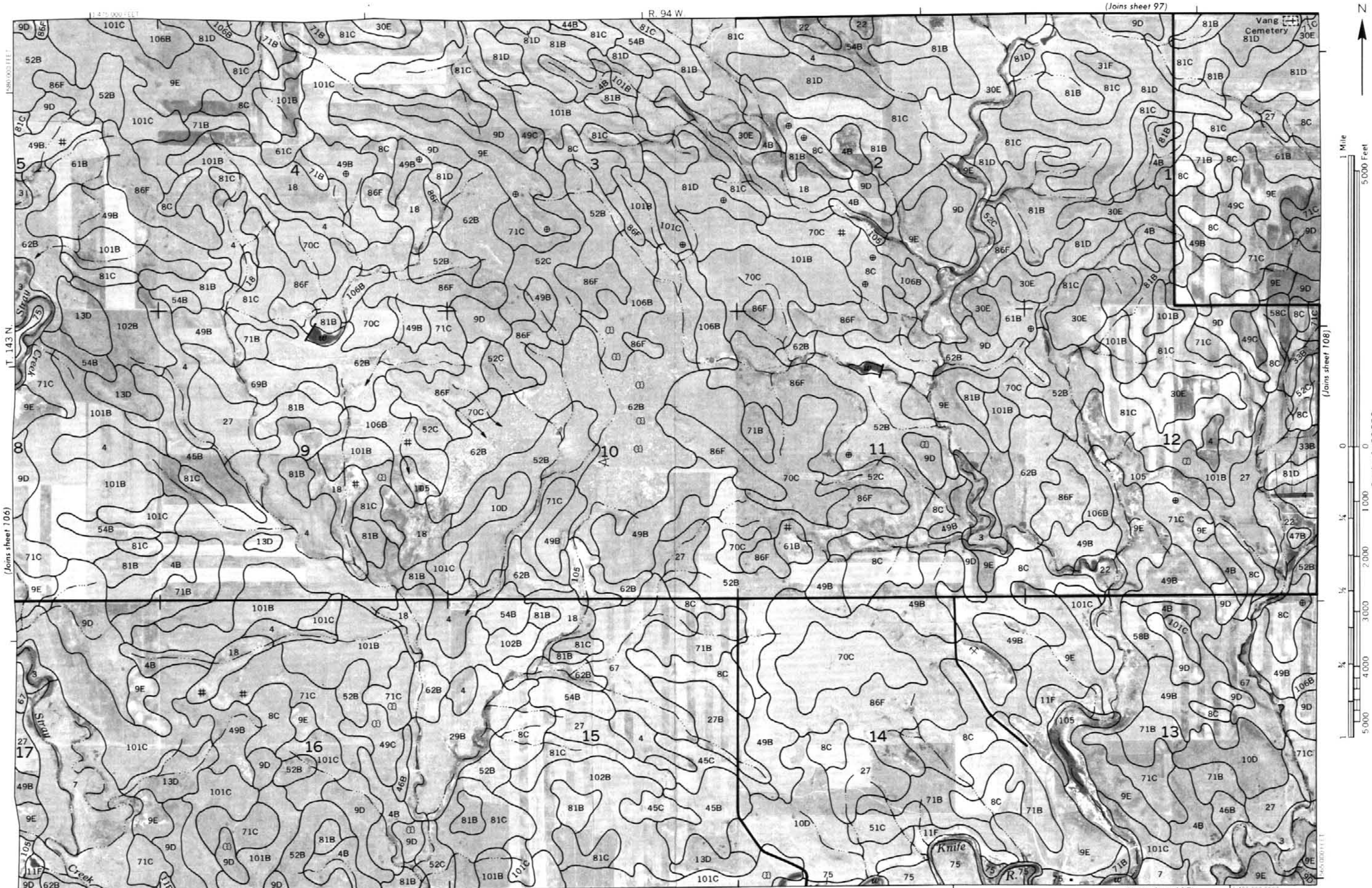
DUNN COUNTY, NORTH DAKOTA NO. 105

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



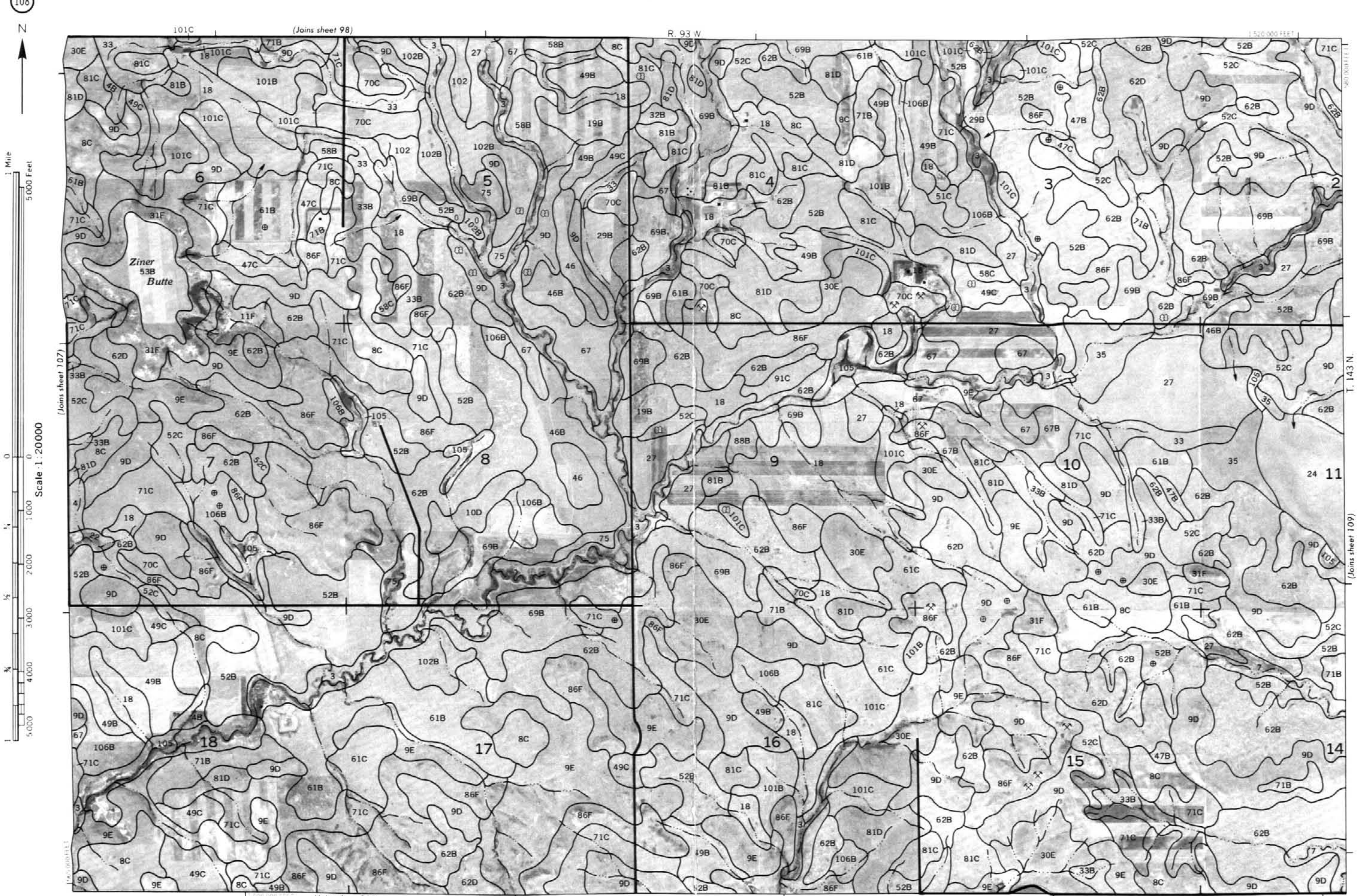
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DUNN COUNTY, NORTH DAKOTA NO. 106



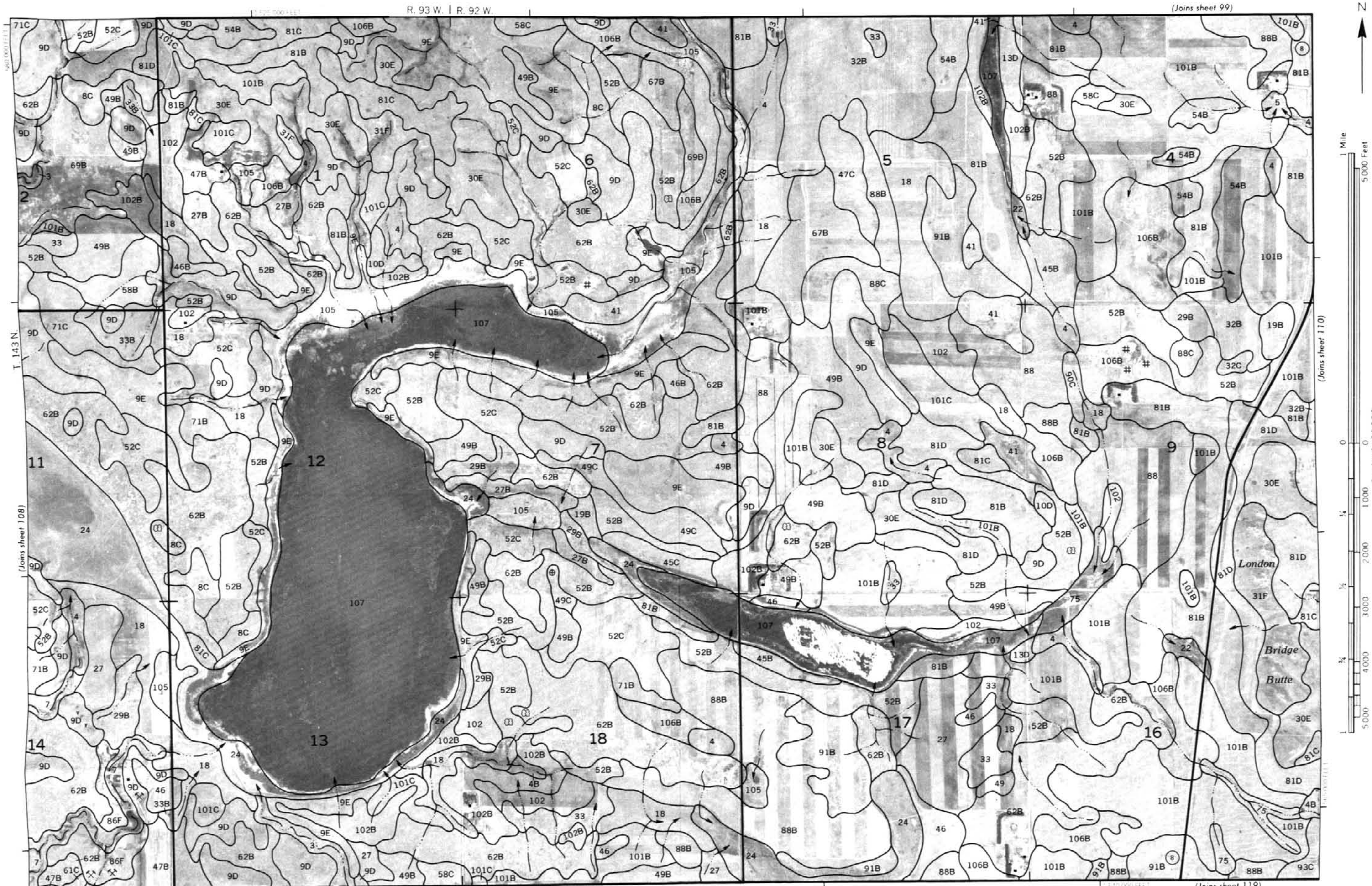
DUNN COUNTY, NORTH DAKOTA NO. 107

DUNN COUNTY, NORTH DAKOTA — SHEET NUMBER 108

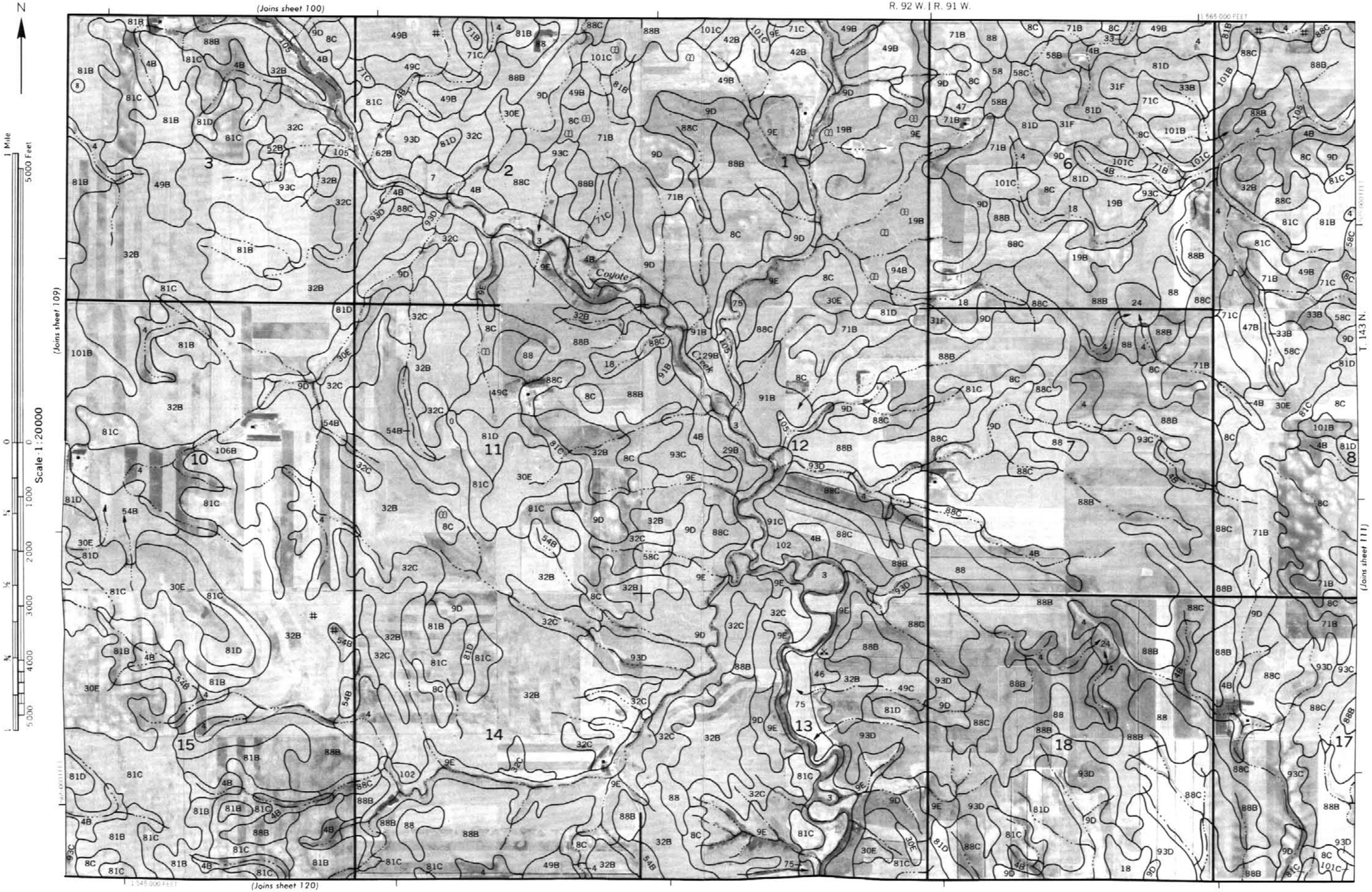


This map is compiled on 1974 aerial photographs by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DUNN COUNTY, NORTH DAKOTA NO. 108

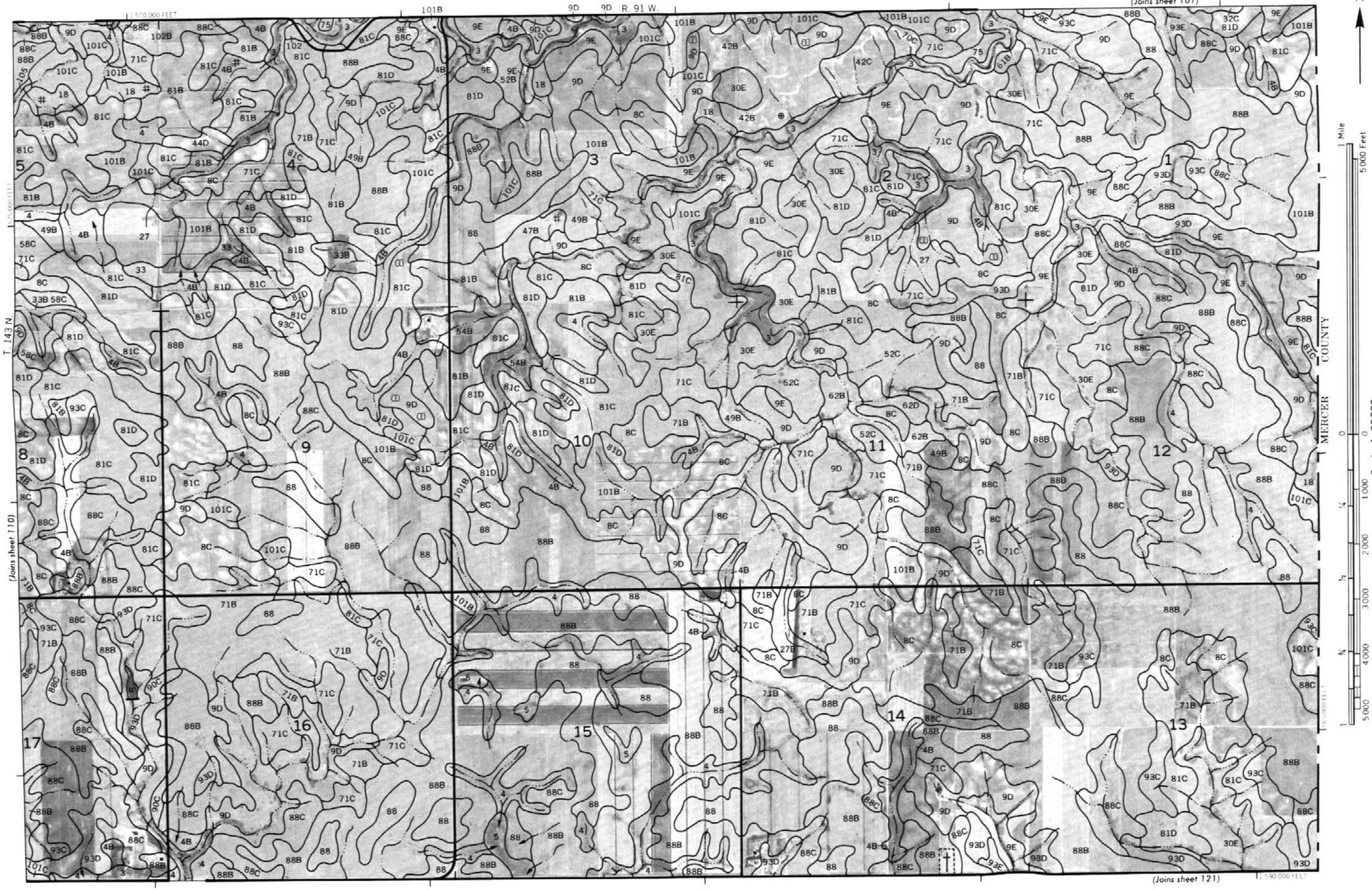


DUNN COUNTY, NORTH DAKOTA NO. 109



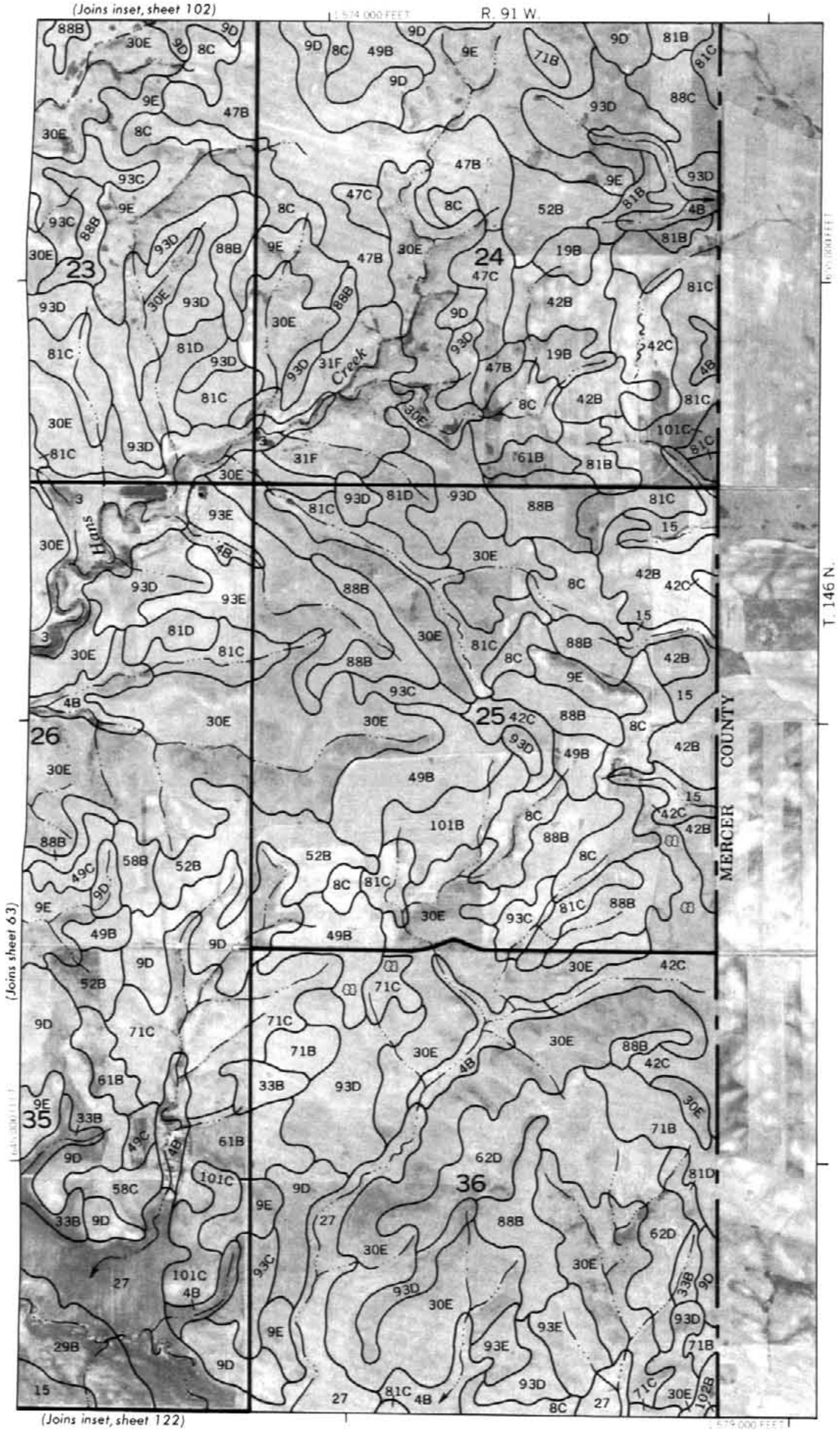
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

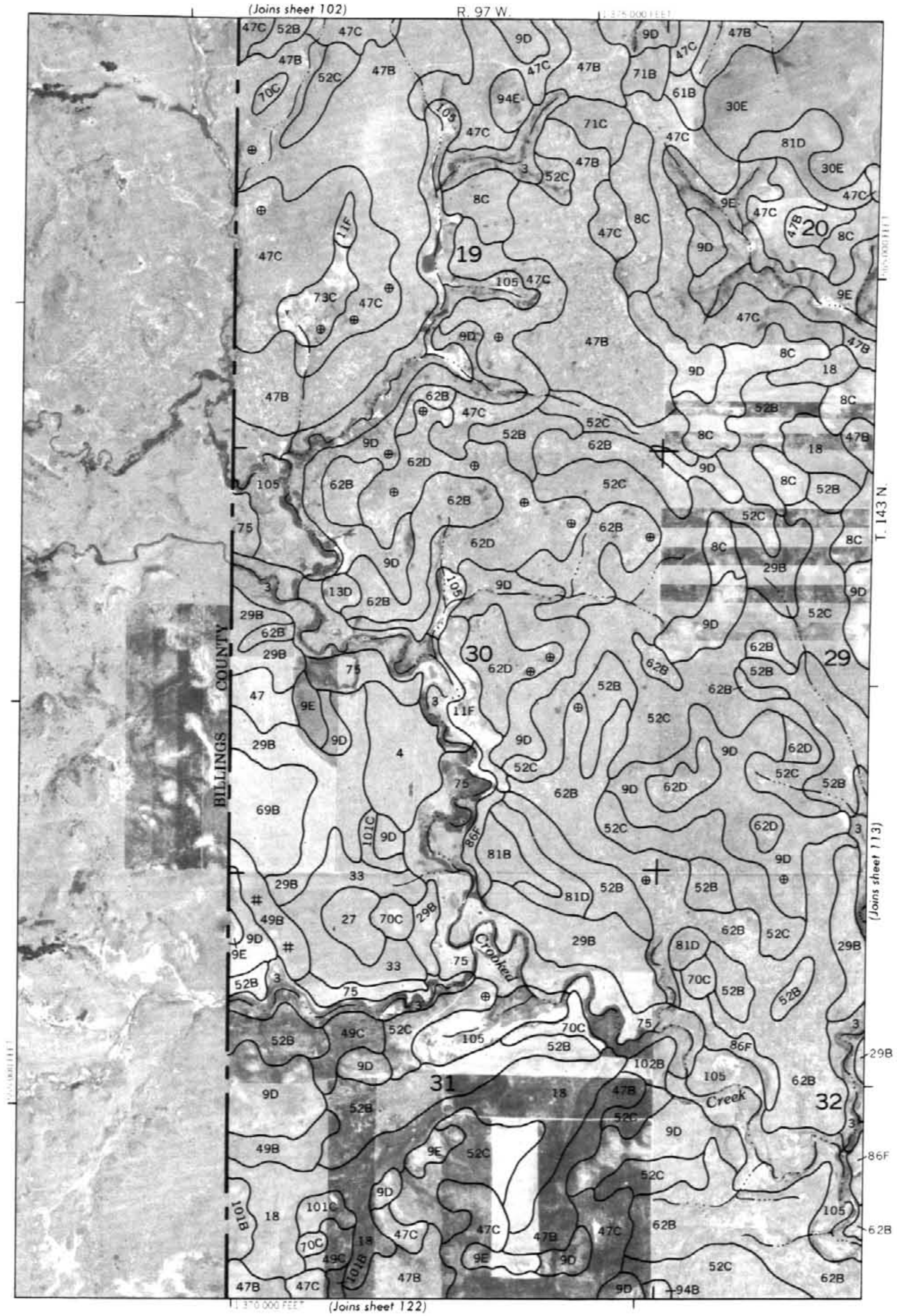
DUNN COUNTY, NORTH DAKOTA NO. 110



DUNN COUNTY, NORTH DAKOTA NO. 111

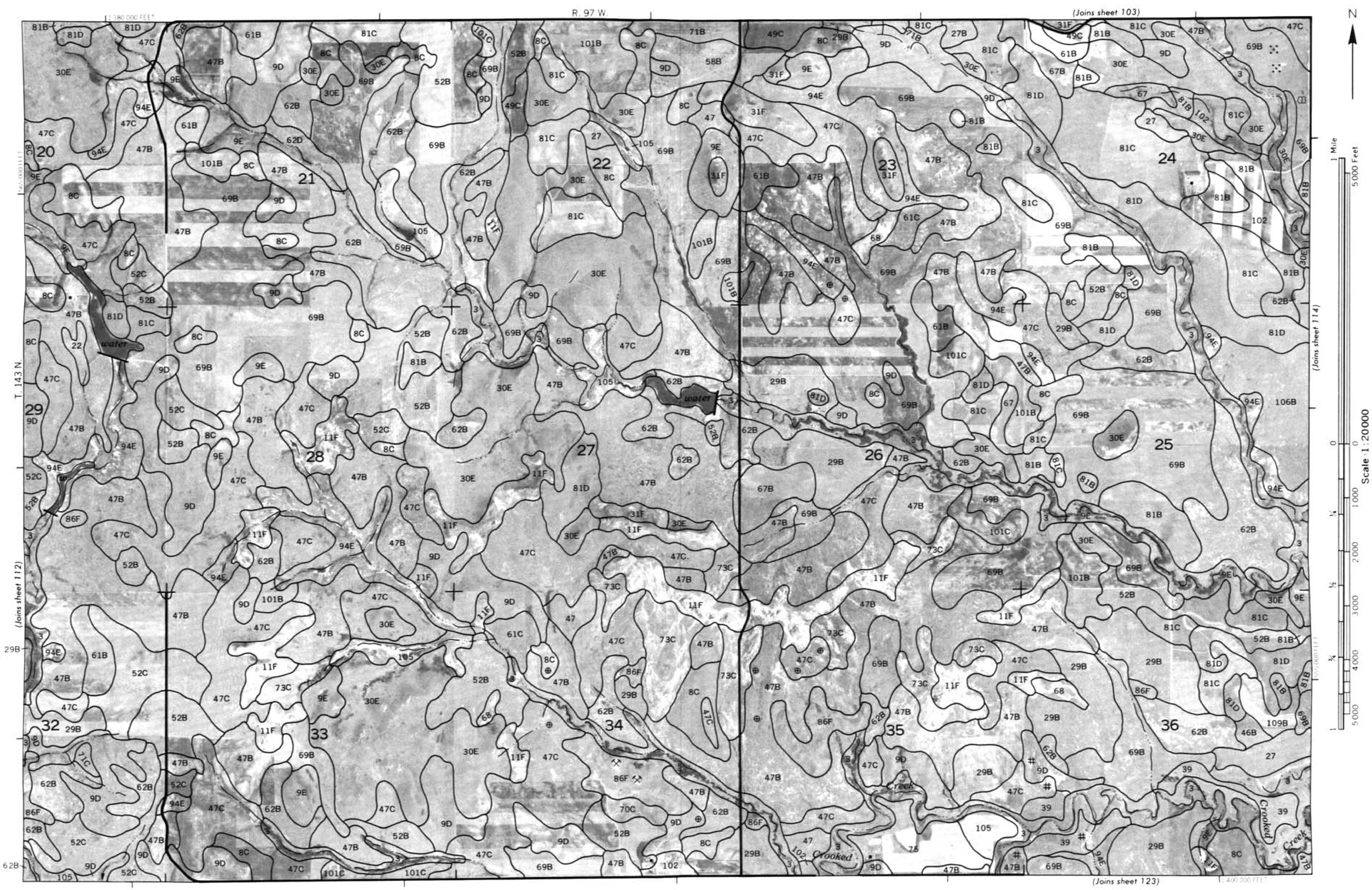
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.





This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

113

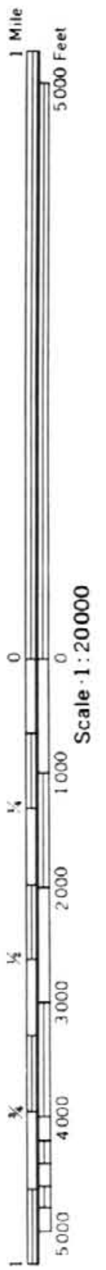


DUNN COUNTY, NORTH DAKOTA NO. 113

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

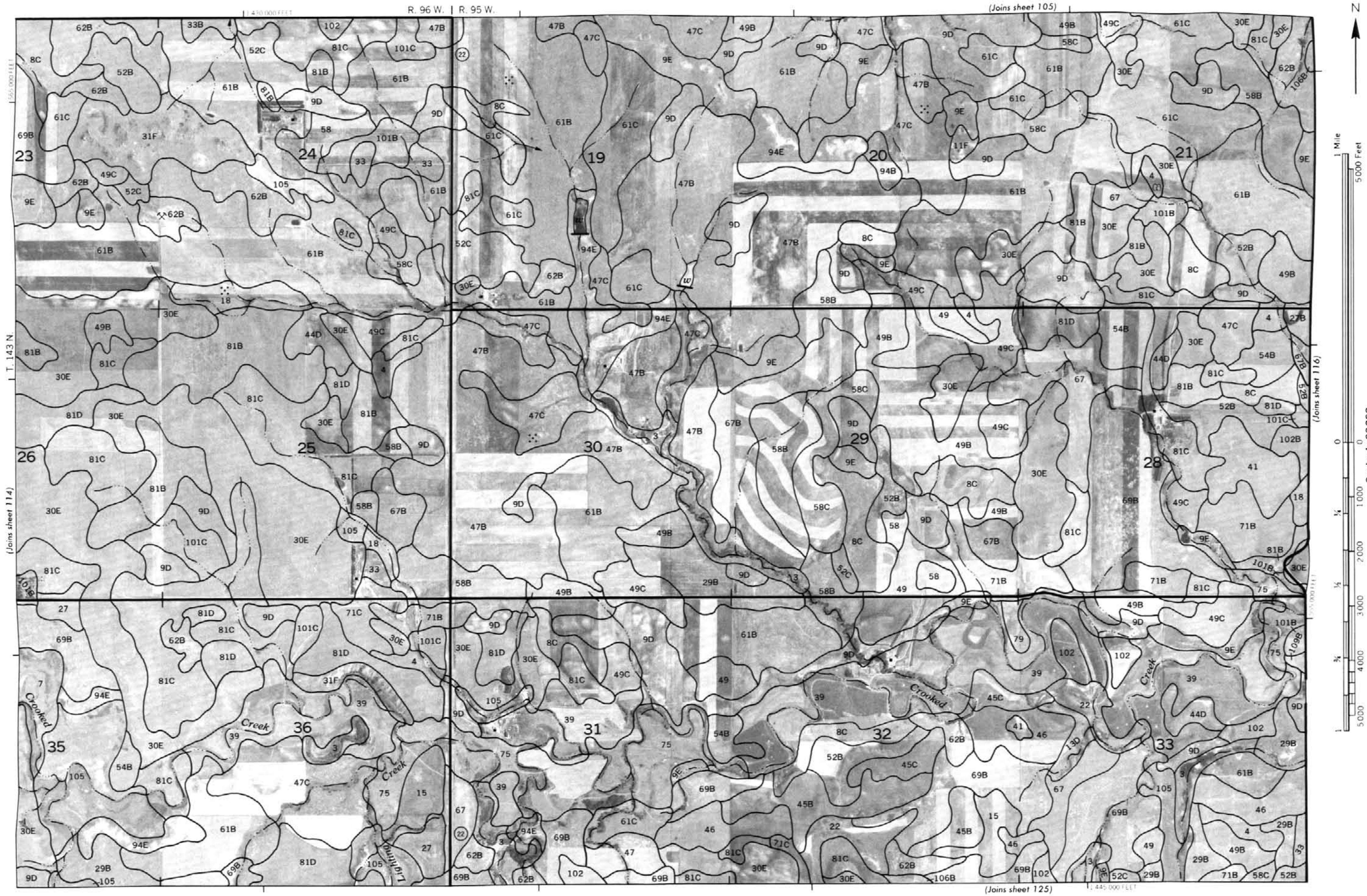
114

N



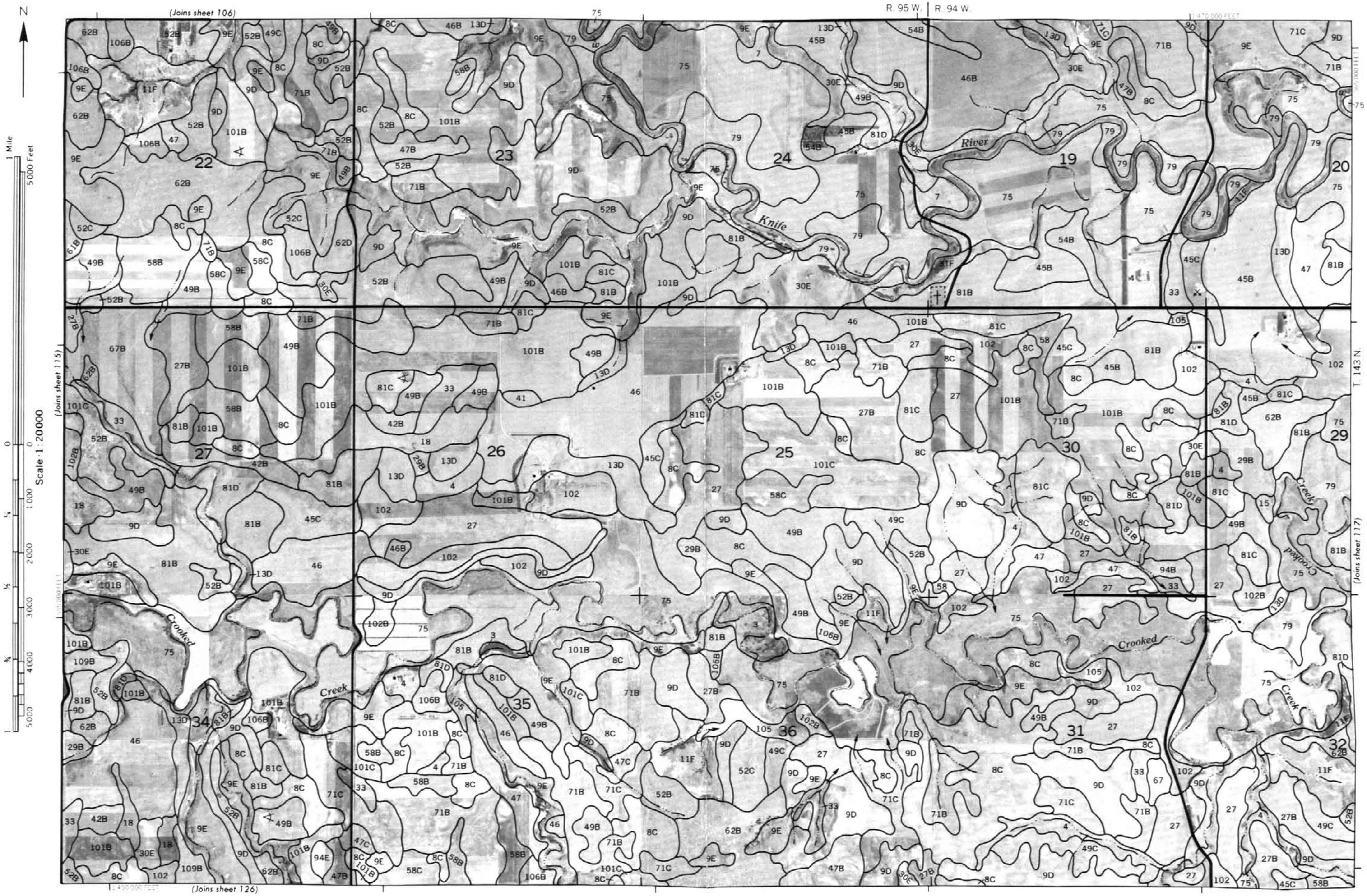
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DUNN COUNTY, NORTH DAKOTA NO. 114



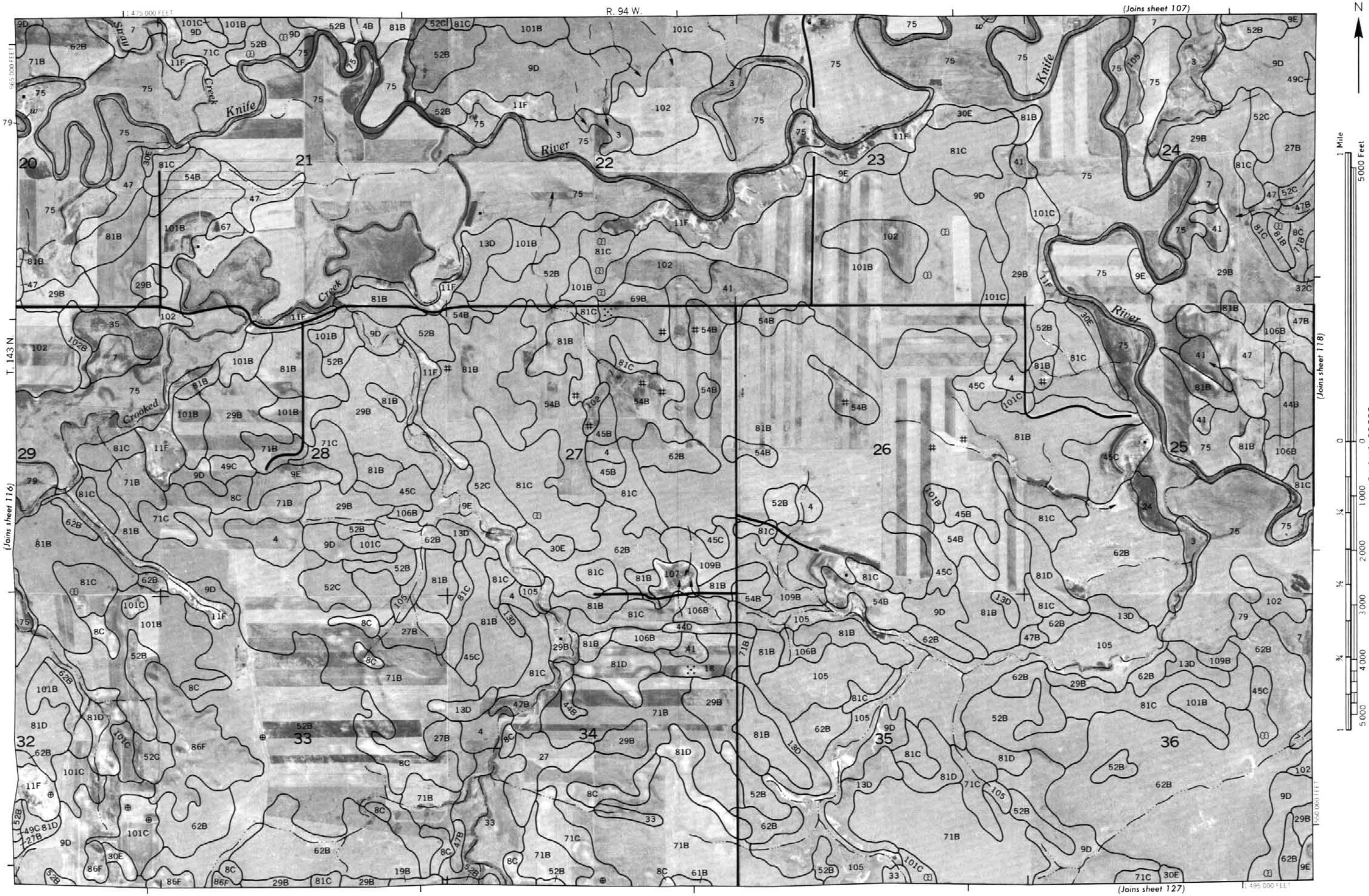
DUNN COUNTY, NORTH DAKOTA NO. 115

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1974 aerial photographs by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

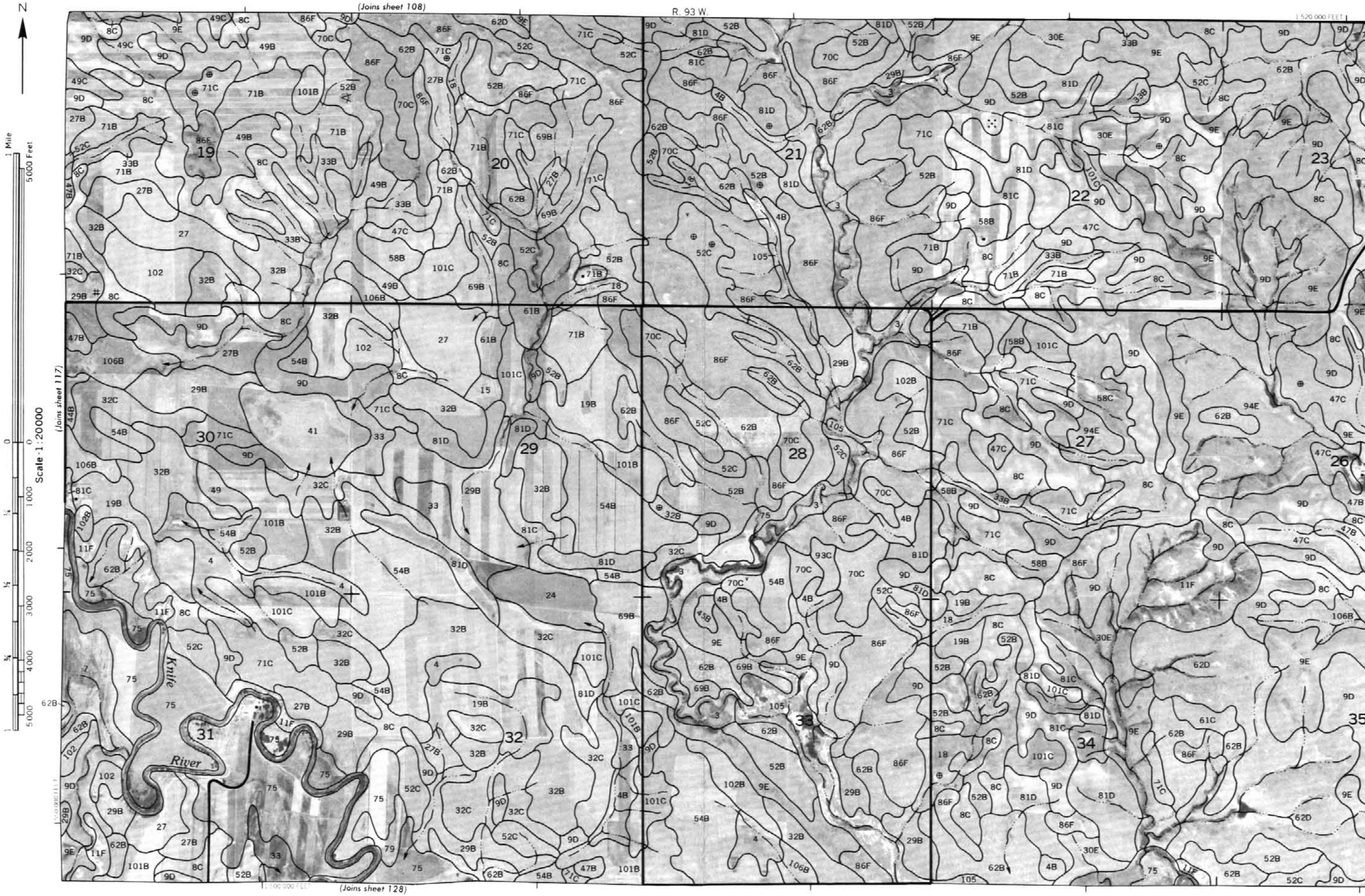
117



DUNN COUNTY, NORTH DAKOTA NO. 117

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DUNN COUNTY, NORTH DAKOTA — SHEET NUMBER 118

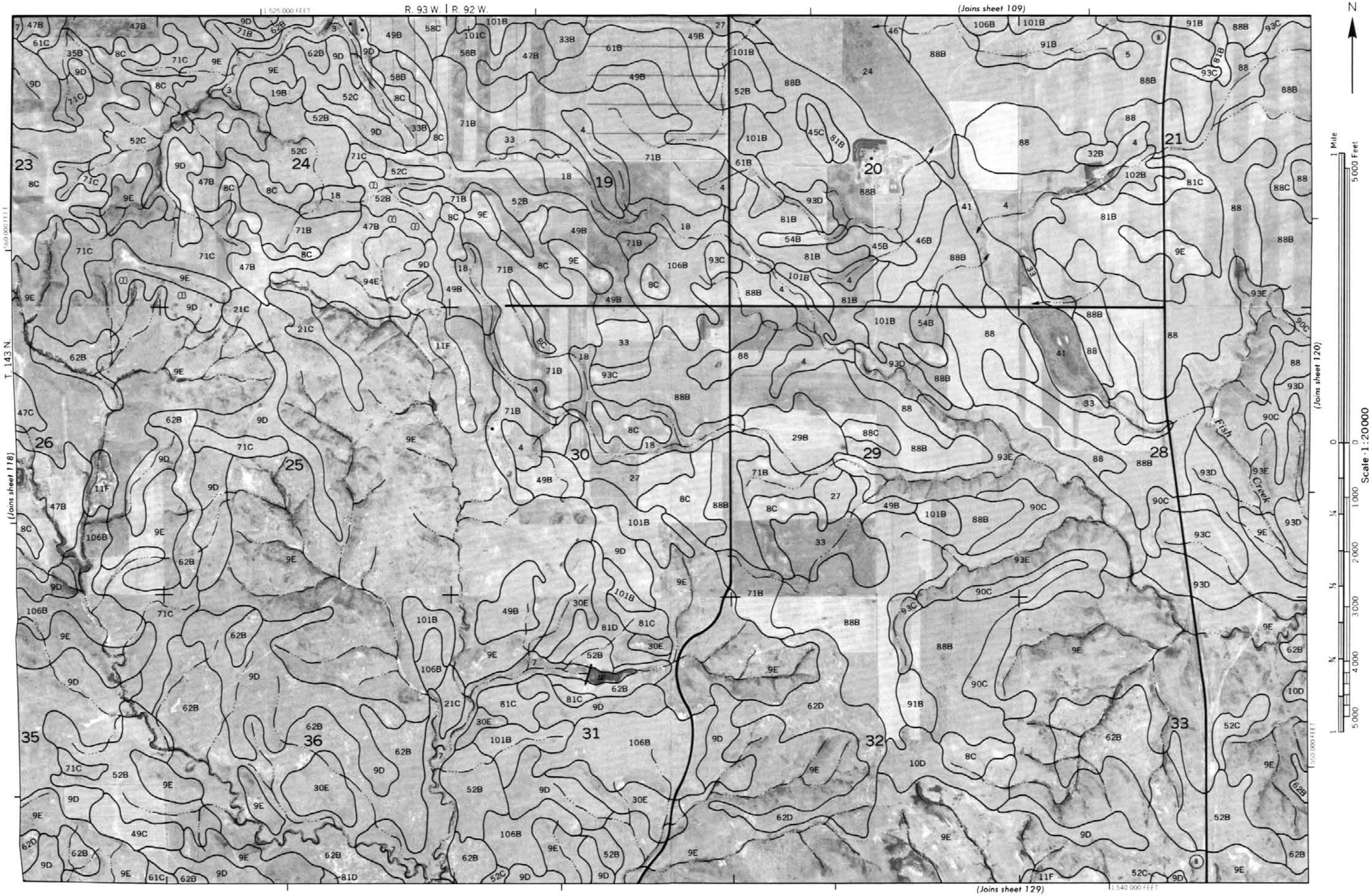


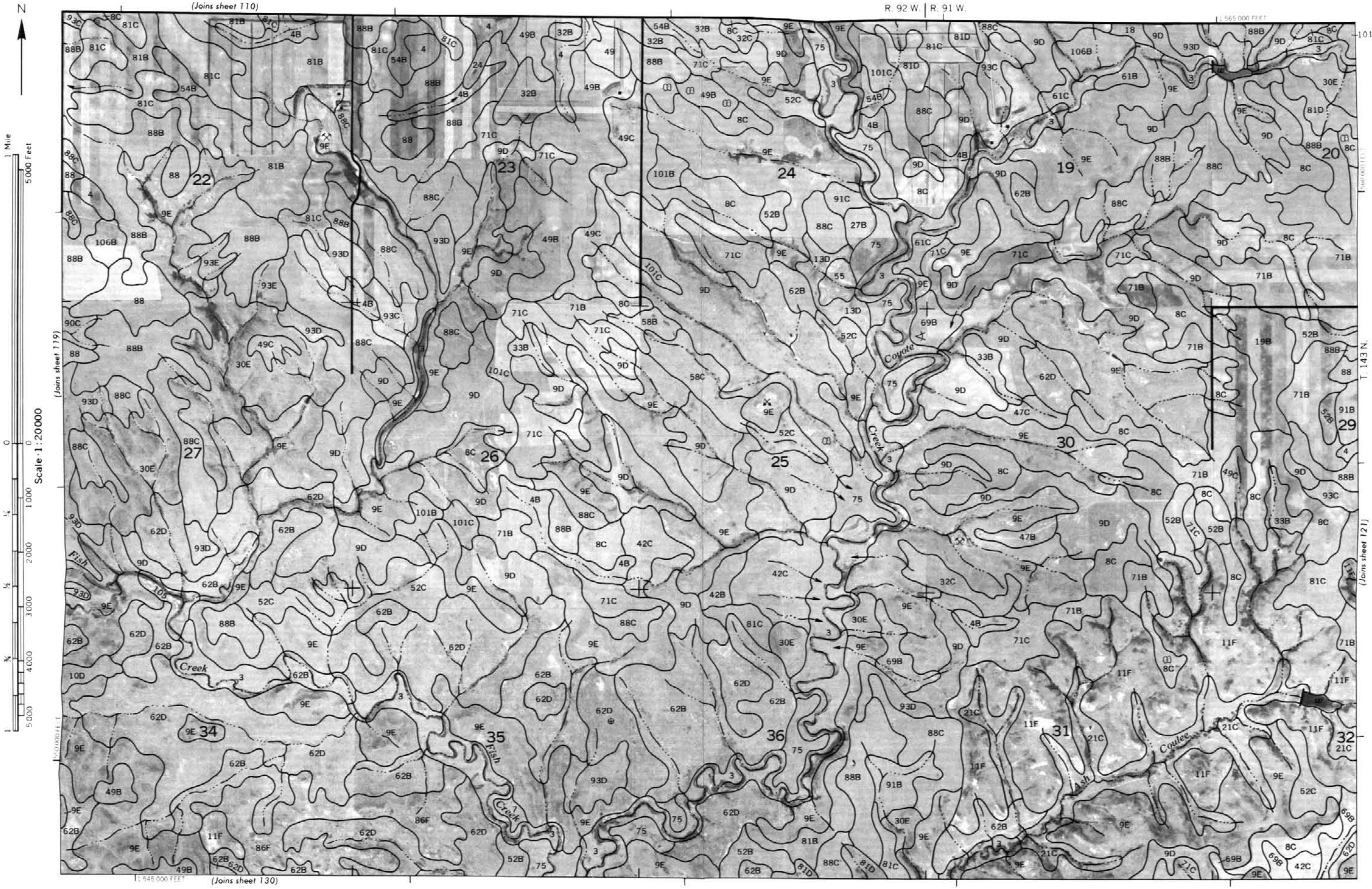
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

119

DUNN COUNTY, NORTH DAKOTA NO. 119

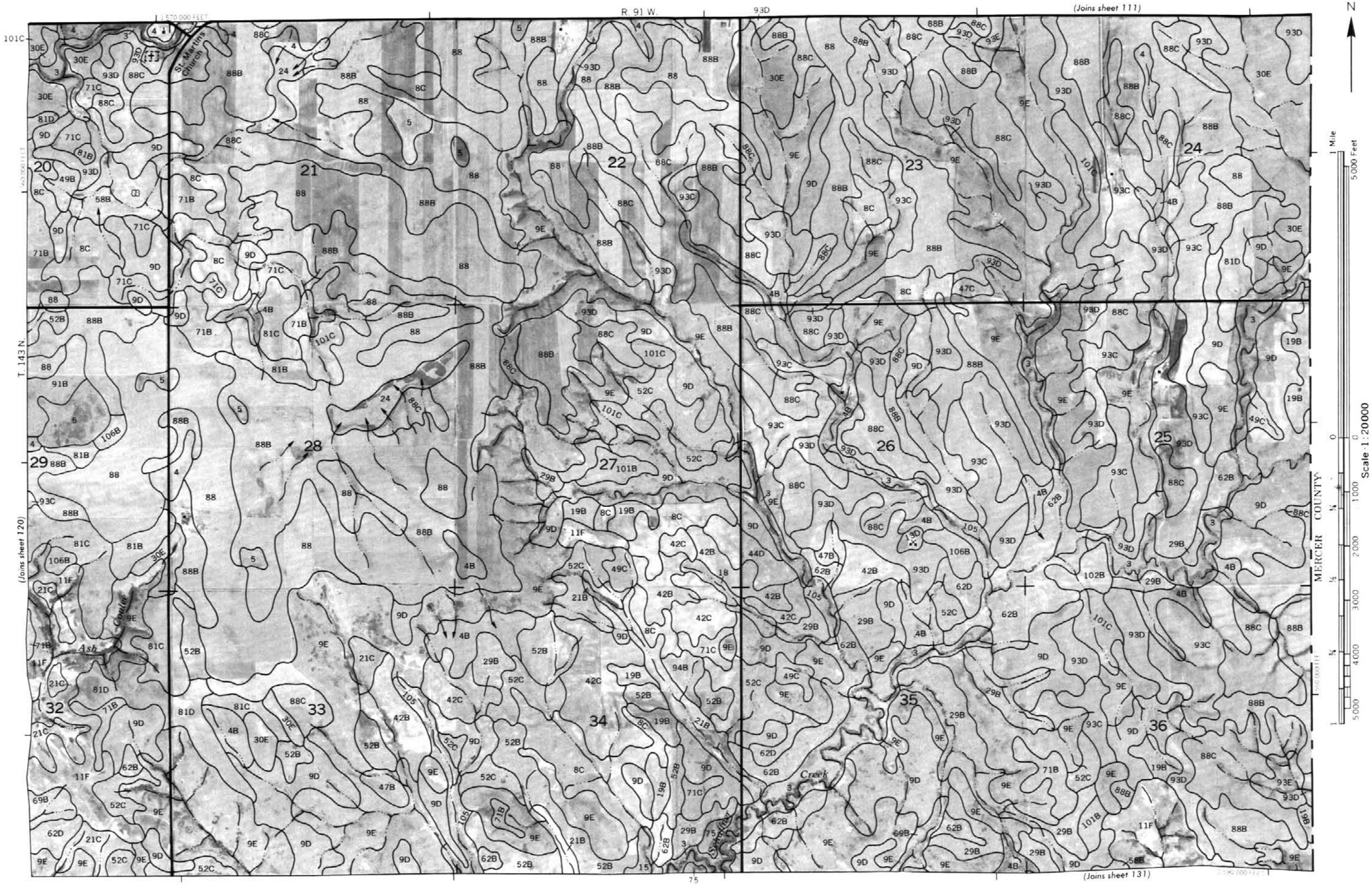
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.





This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DUNN COUNTY, NORTH DAKOTA NO. 120

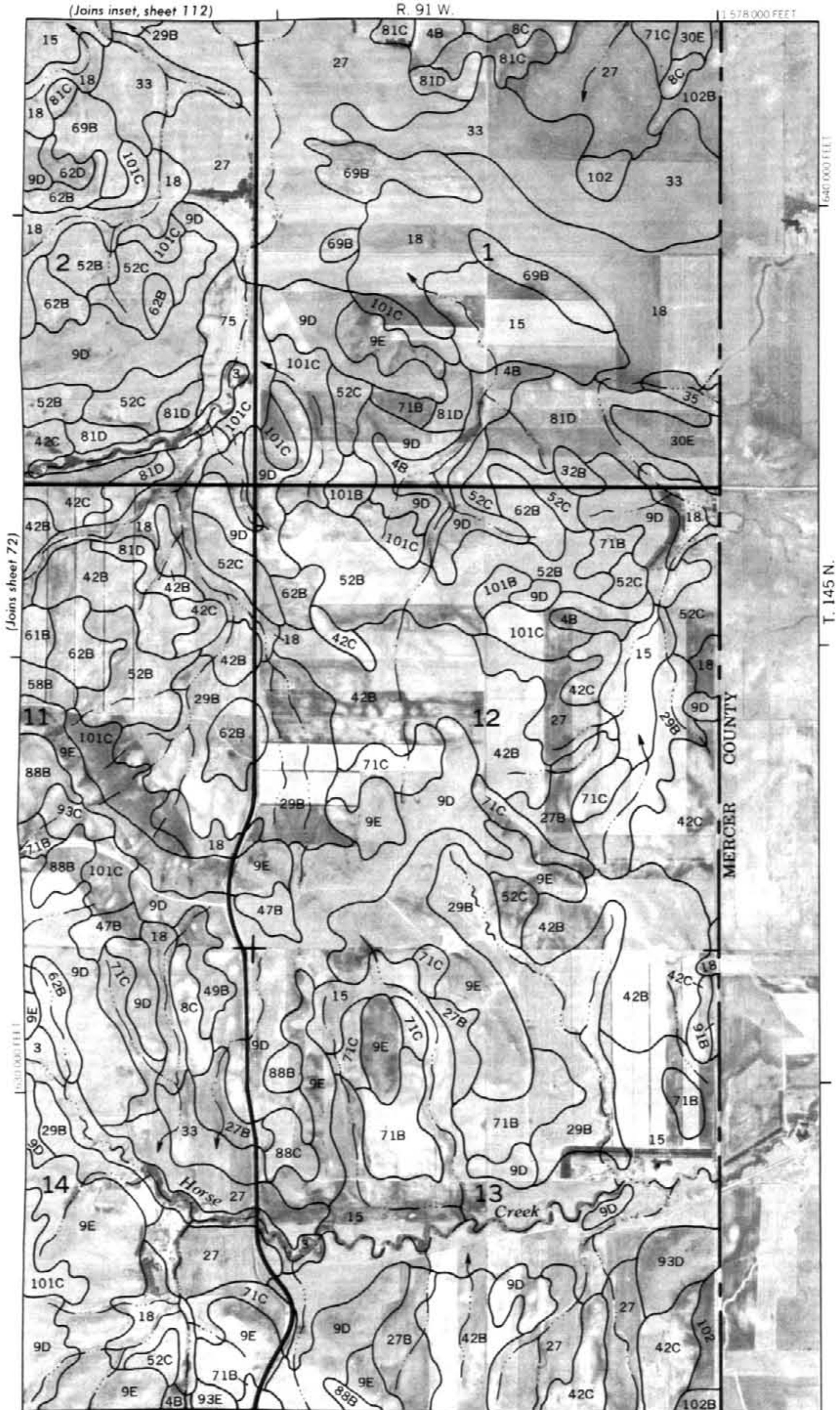


DUNN COUNTY, NORTH DAKOTA NO. 121

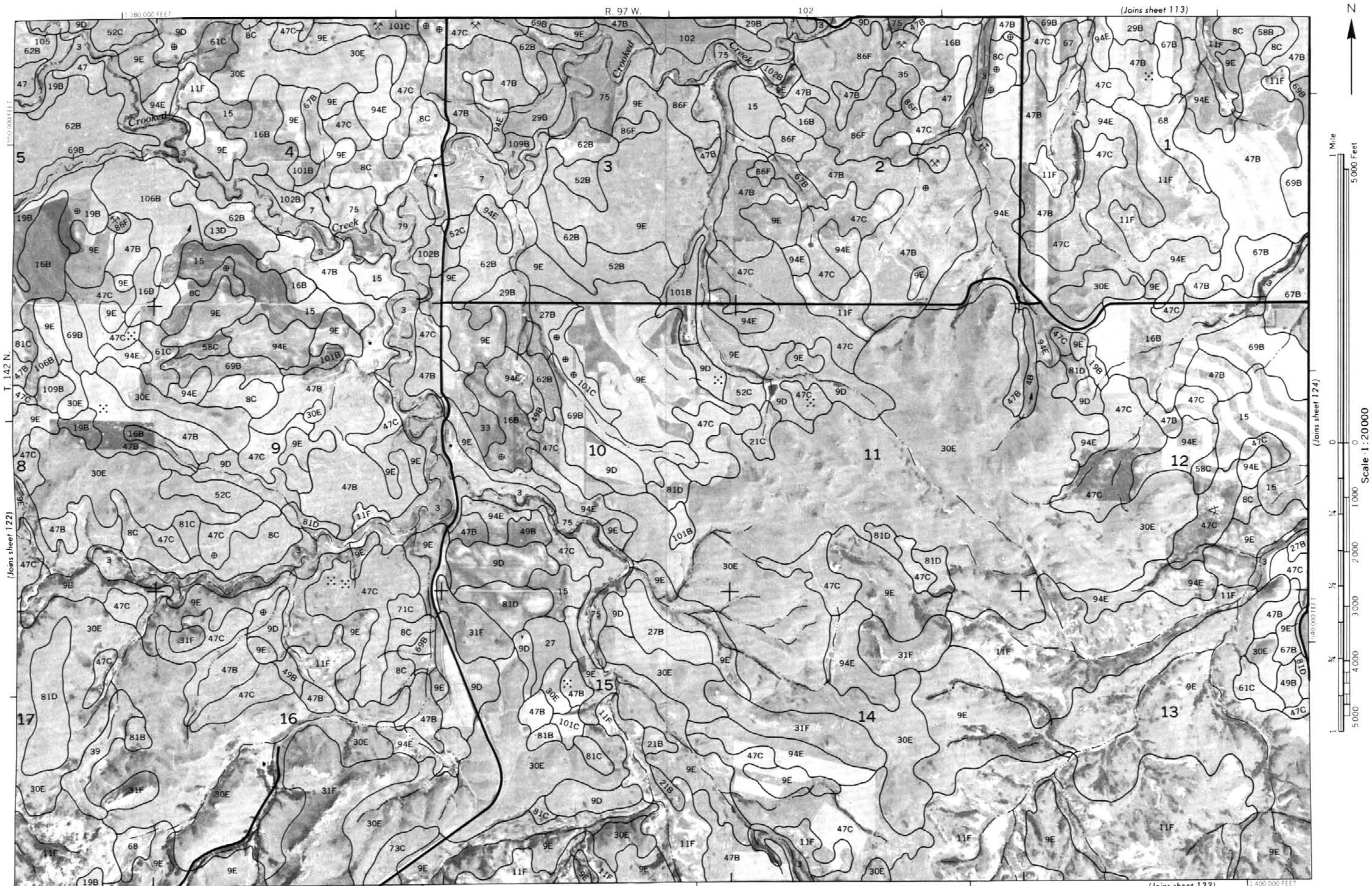
This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

N

1 Mile
5000 Feet
Scale 1:20000
0 1000 2000 3000 4000 5000

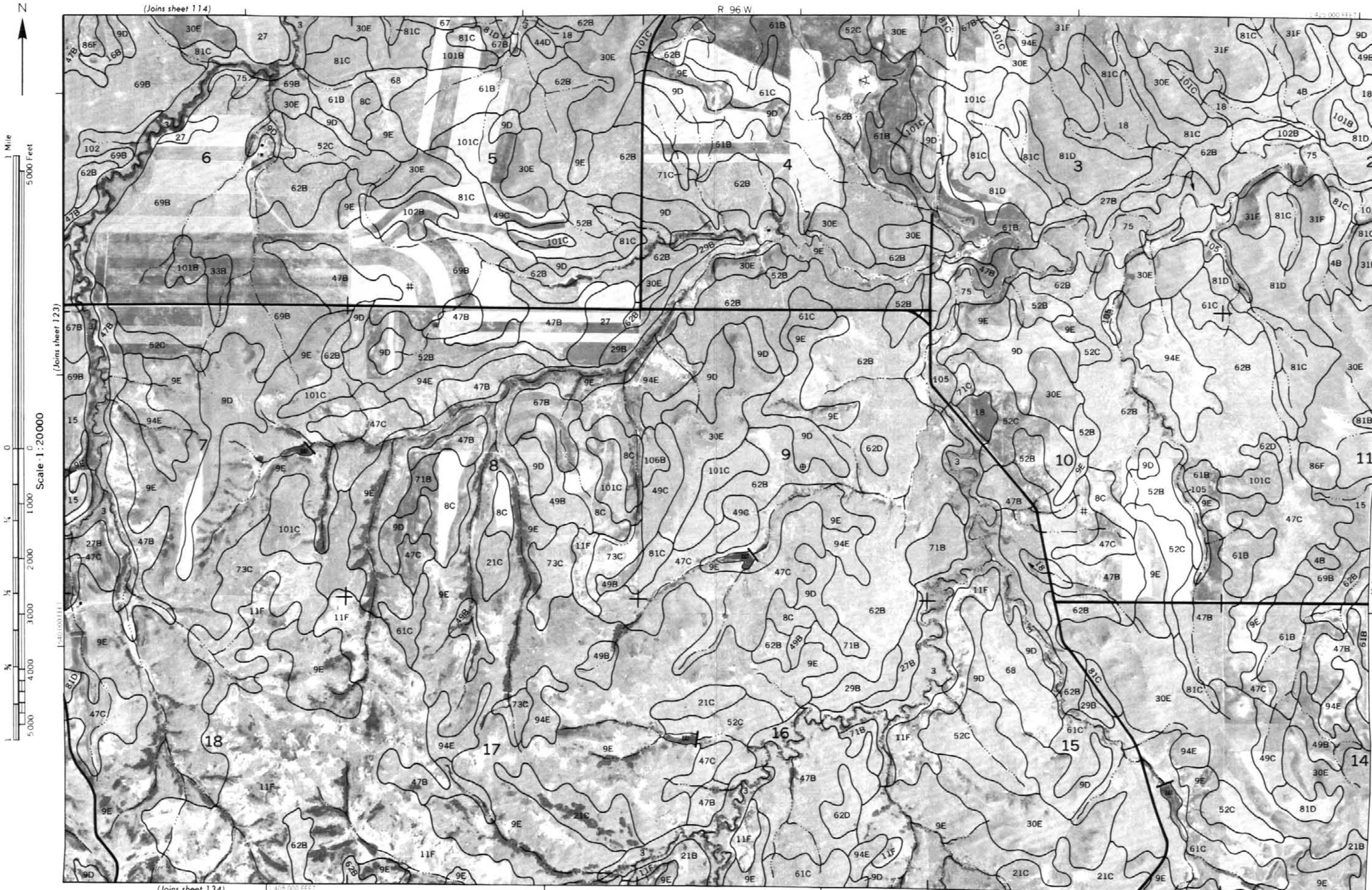


This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



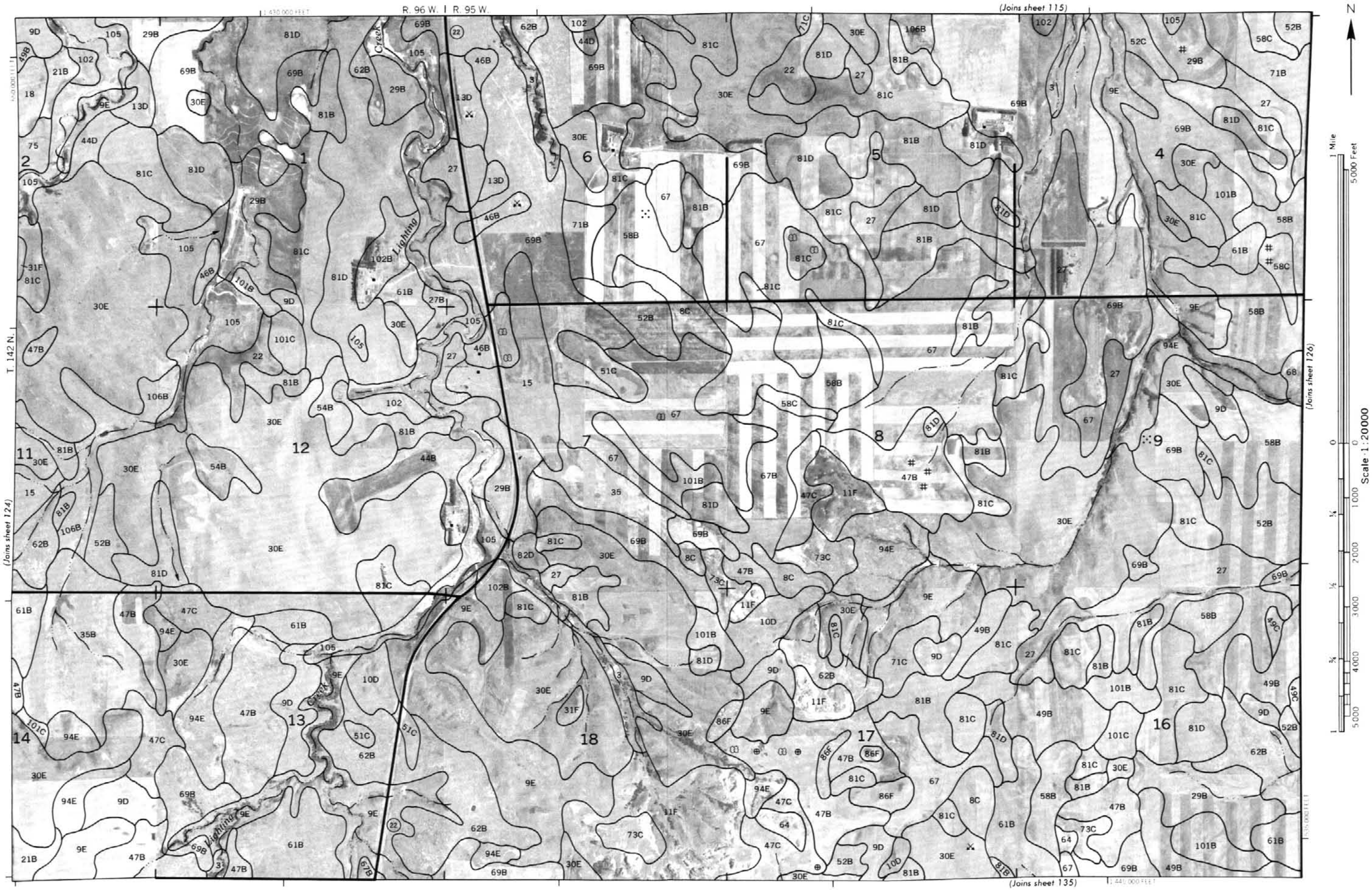
DUNN COUNTY, NORTH DAKOTA NO. 123

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



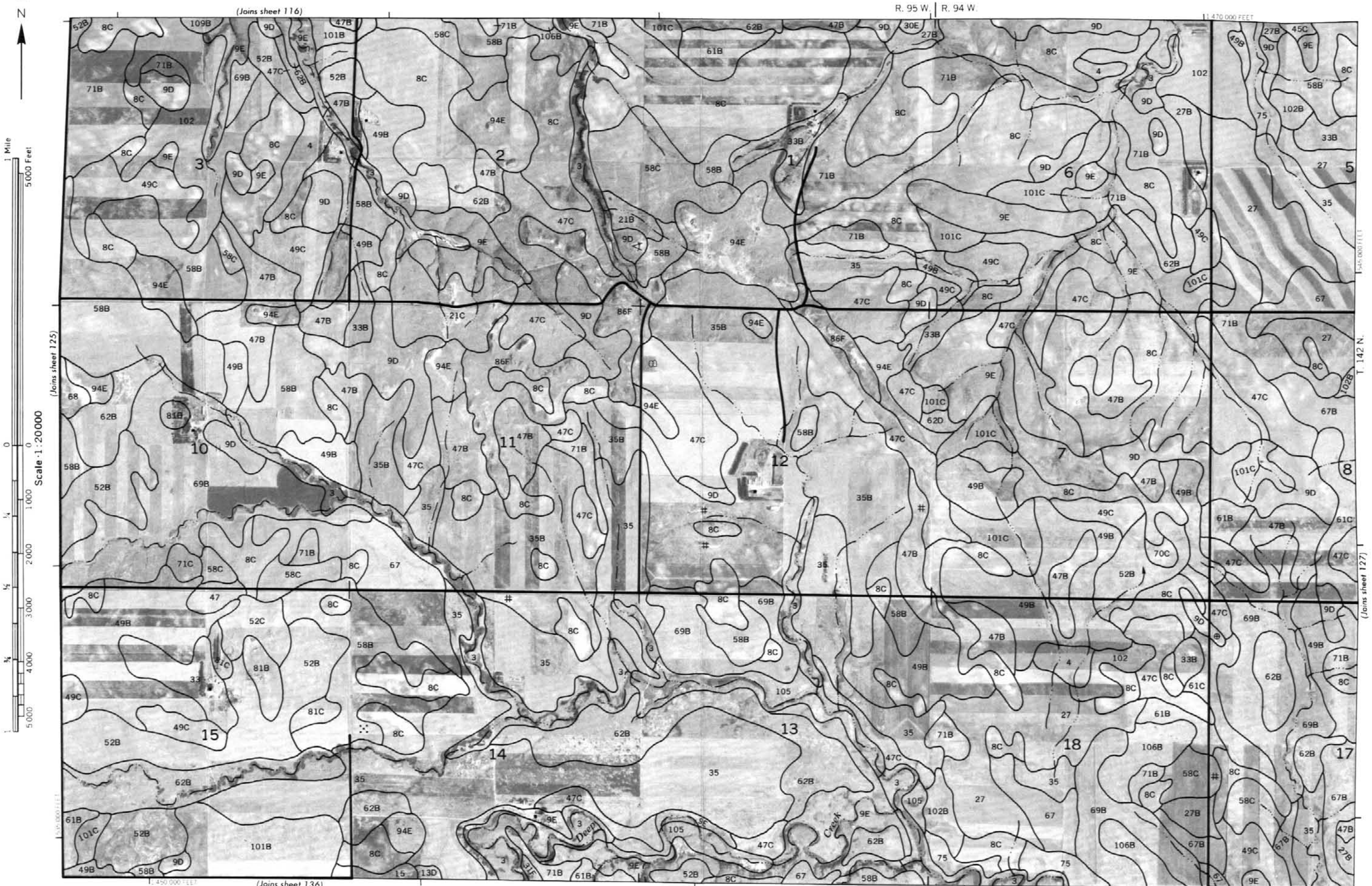
This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DUNN COUNTY, NORTH DAKOTA NO. 124



DUNN COUNTY, NORTH DAKOTA NO. 125

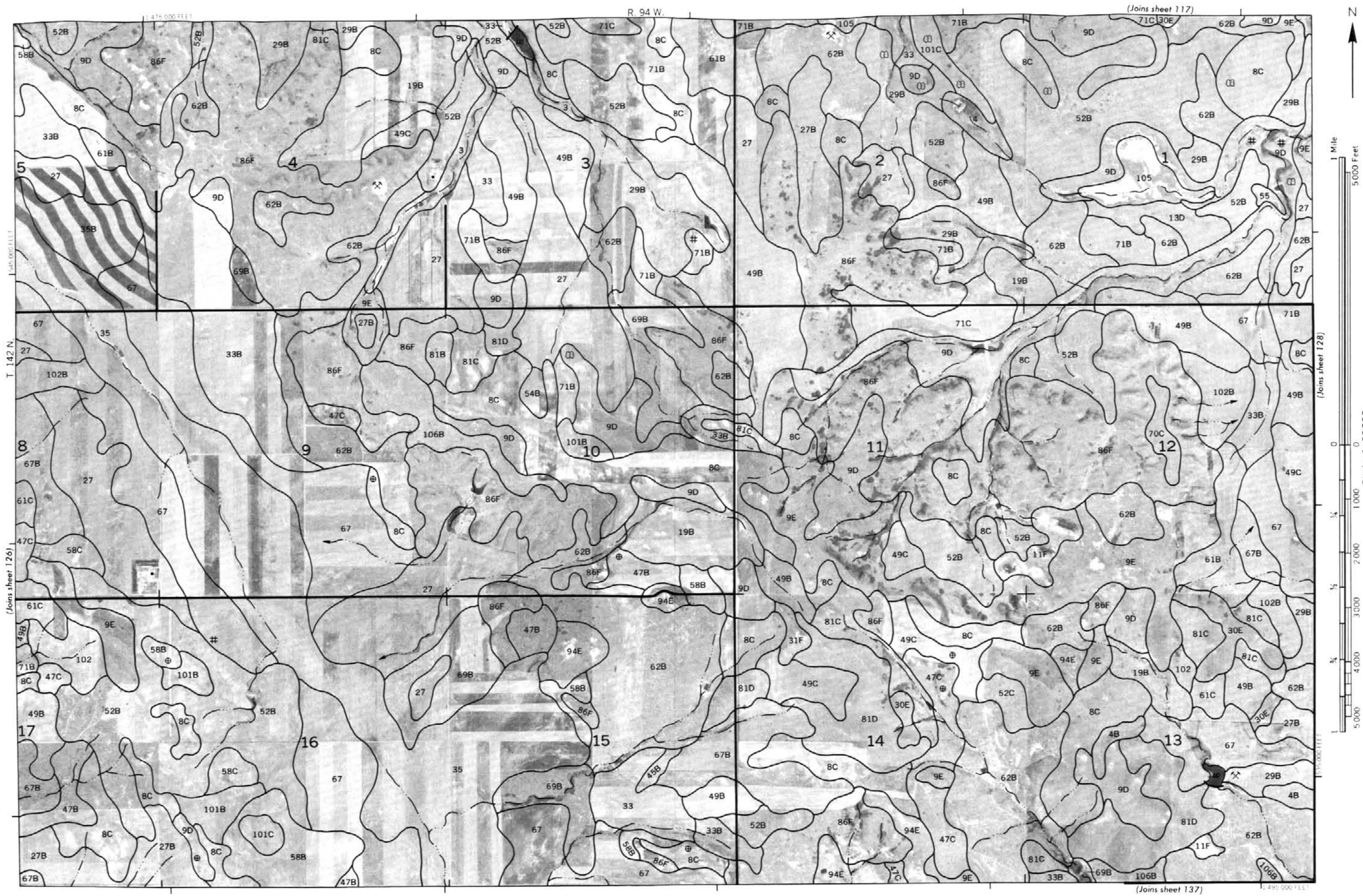
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

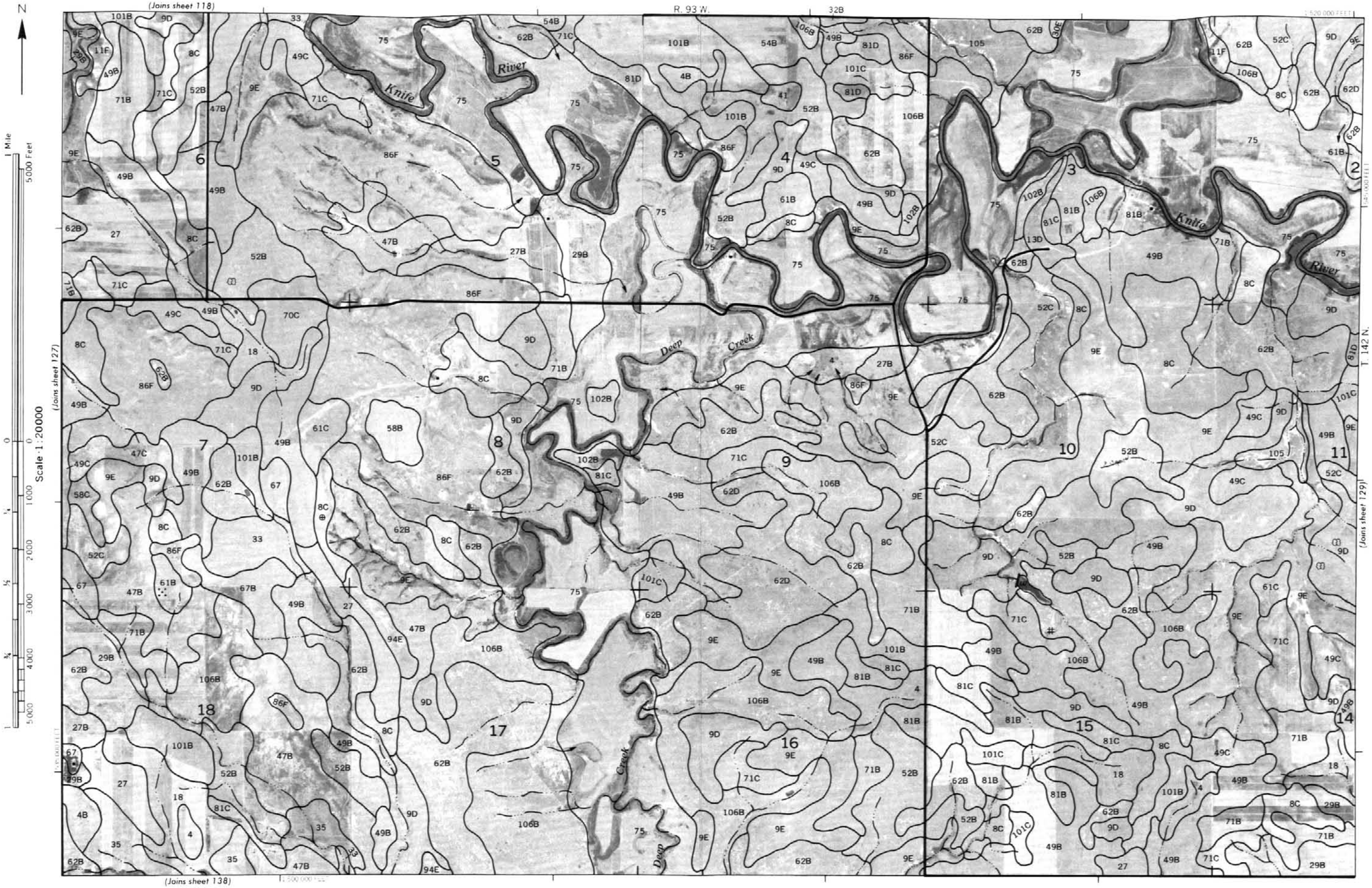


This map is compiled on 1973 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

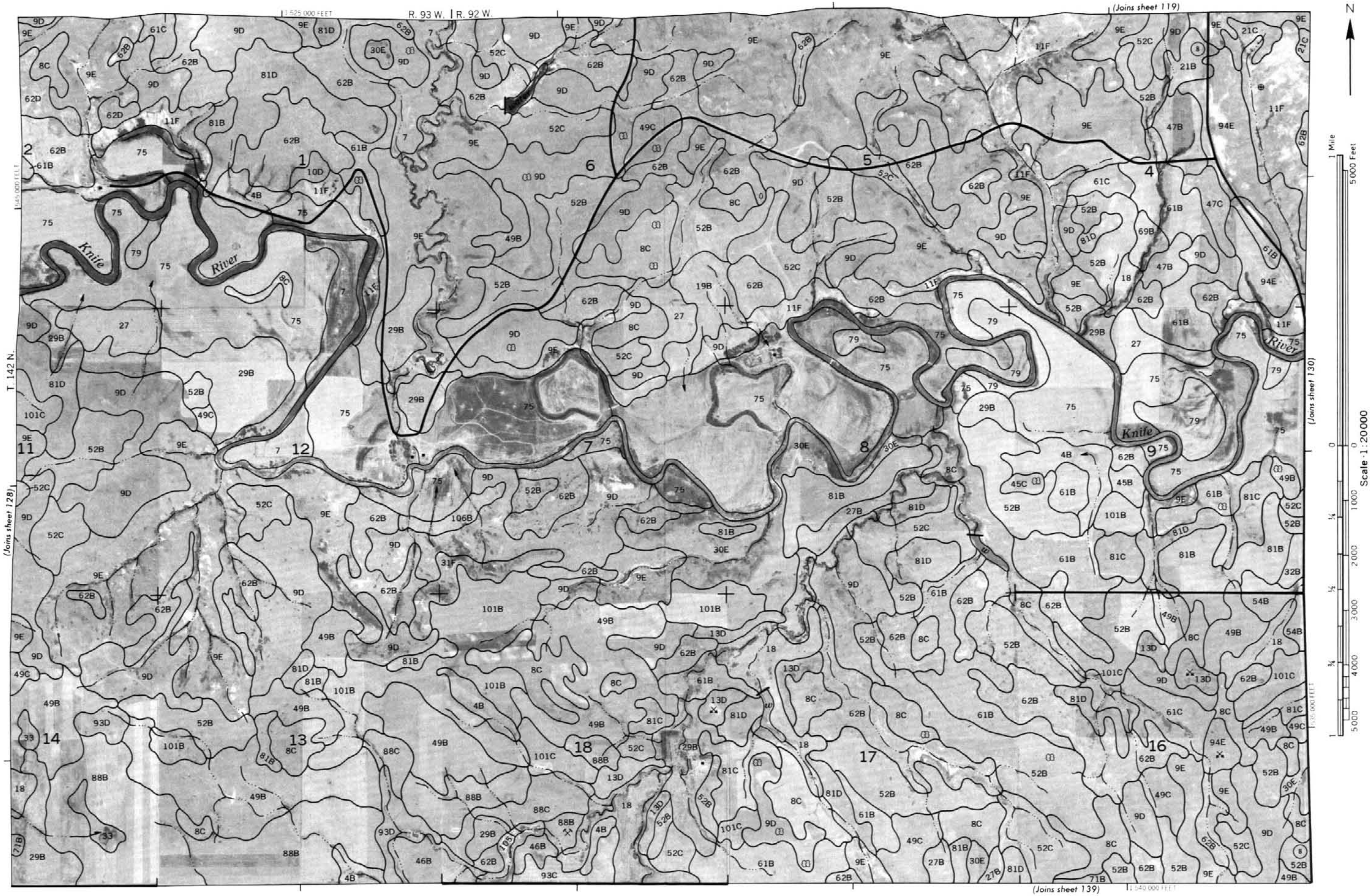
DUNN COUNTY, NORTH DAKOTA NO. 126

DUNN COUNTY, NORTH DAKOTA — SHEET NUMBER 127





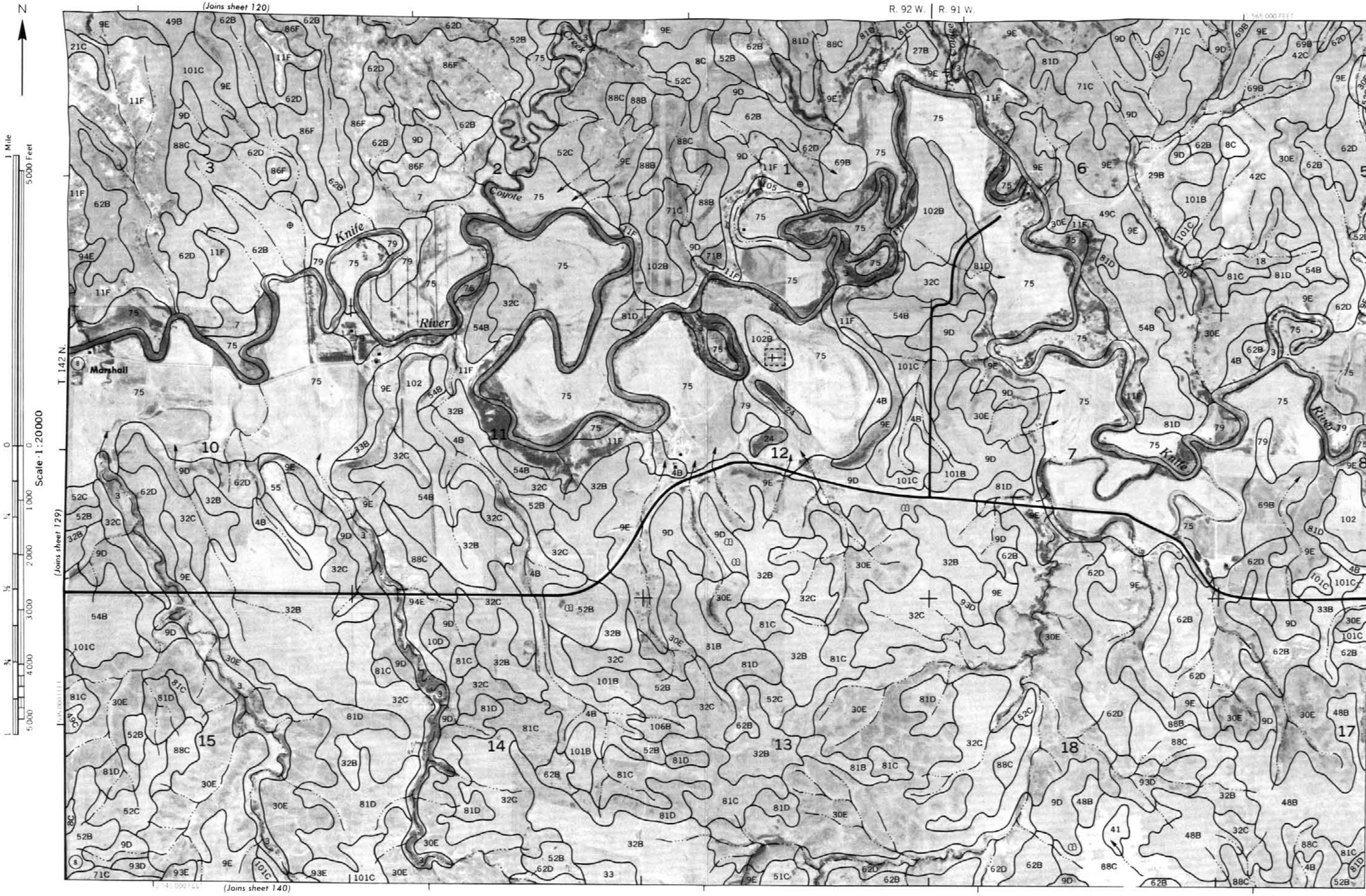
DUNN COUNTY, NORTH DAKOTA NO. 128



DUNN COUNTY, NORTH DAKOTA NO. 129

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

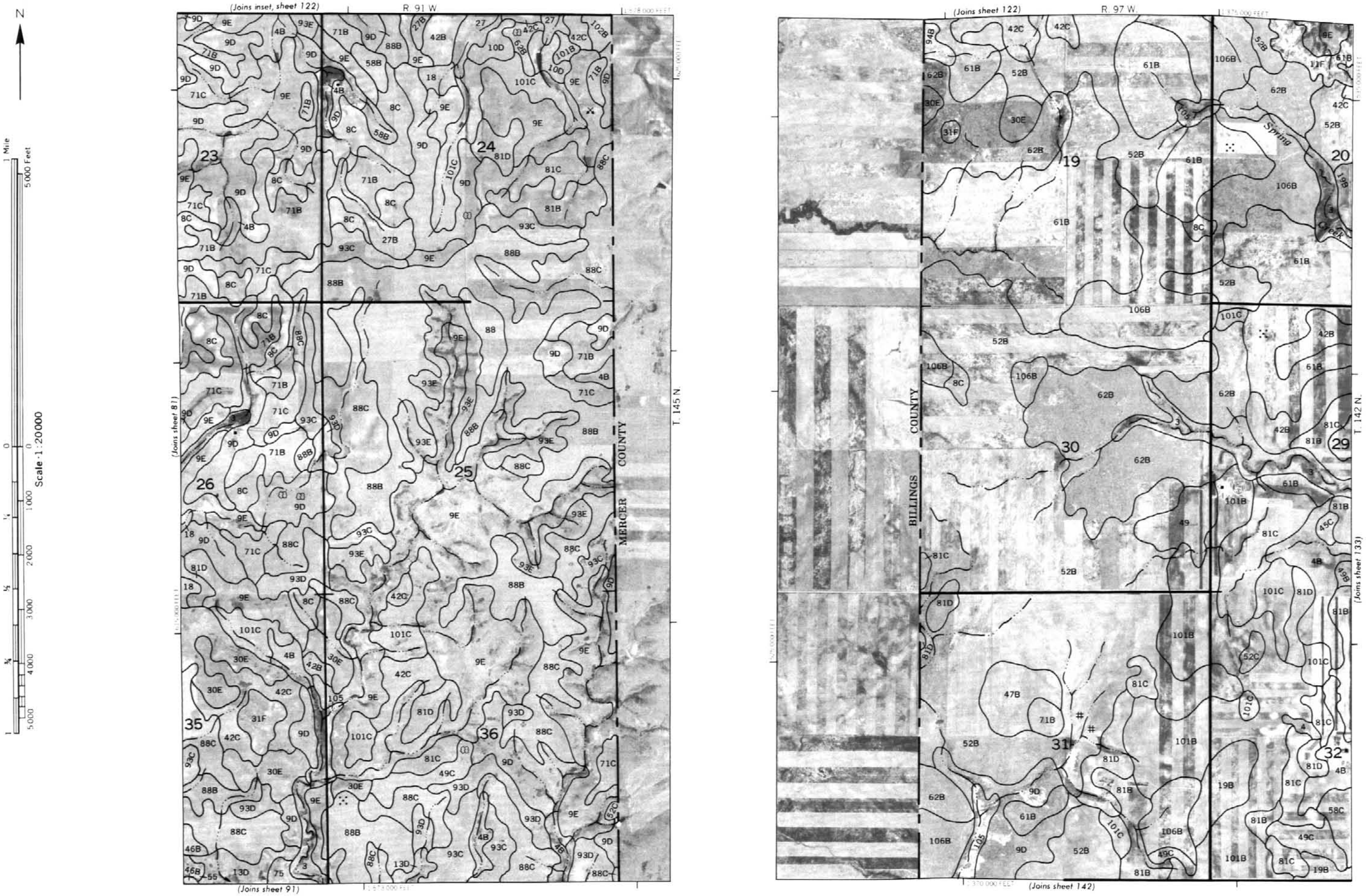
DUNN COUNTY, NORTH DAKOTA — SHEET NUMBER 130



This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

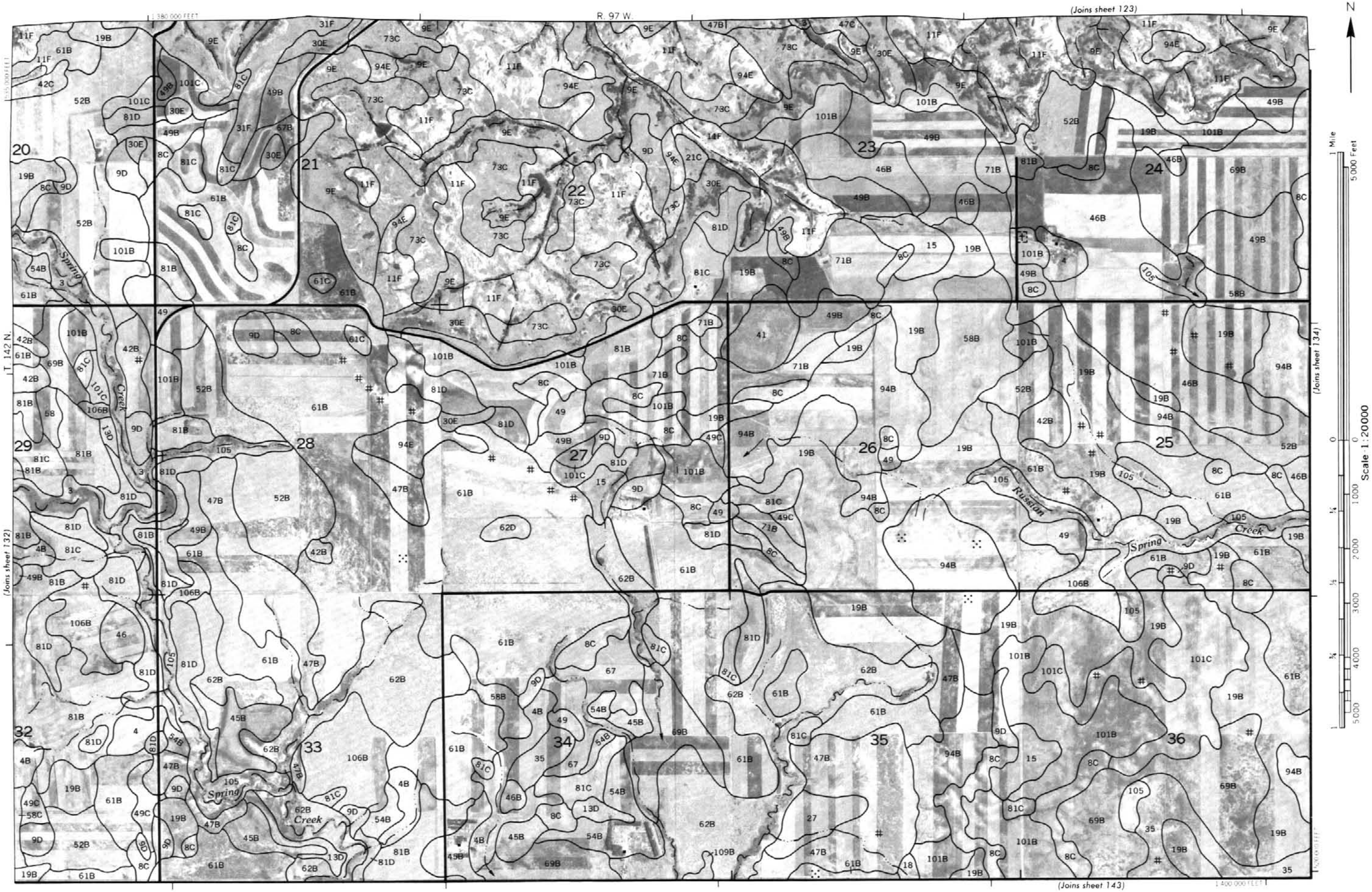
DUNN COUNTY, NORTH DAKOTA NO. 130


131
N
(Joins sheet 121)
R. 91 W.
T. 142 N.
(Joins sheet 130)
(Joins sheet 141)
MERCER COUNTY
Knife River
Schaffner Creek
Knife River Branch
1 Mile
5000 Feet
Scale 1:20000
0
1000
2000
3000
4000
5000
1 570 000 FEET
DUNN COUNTY, NORTH DAKOTA NO. 131



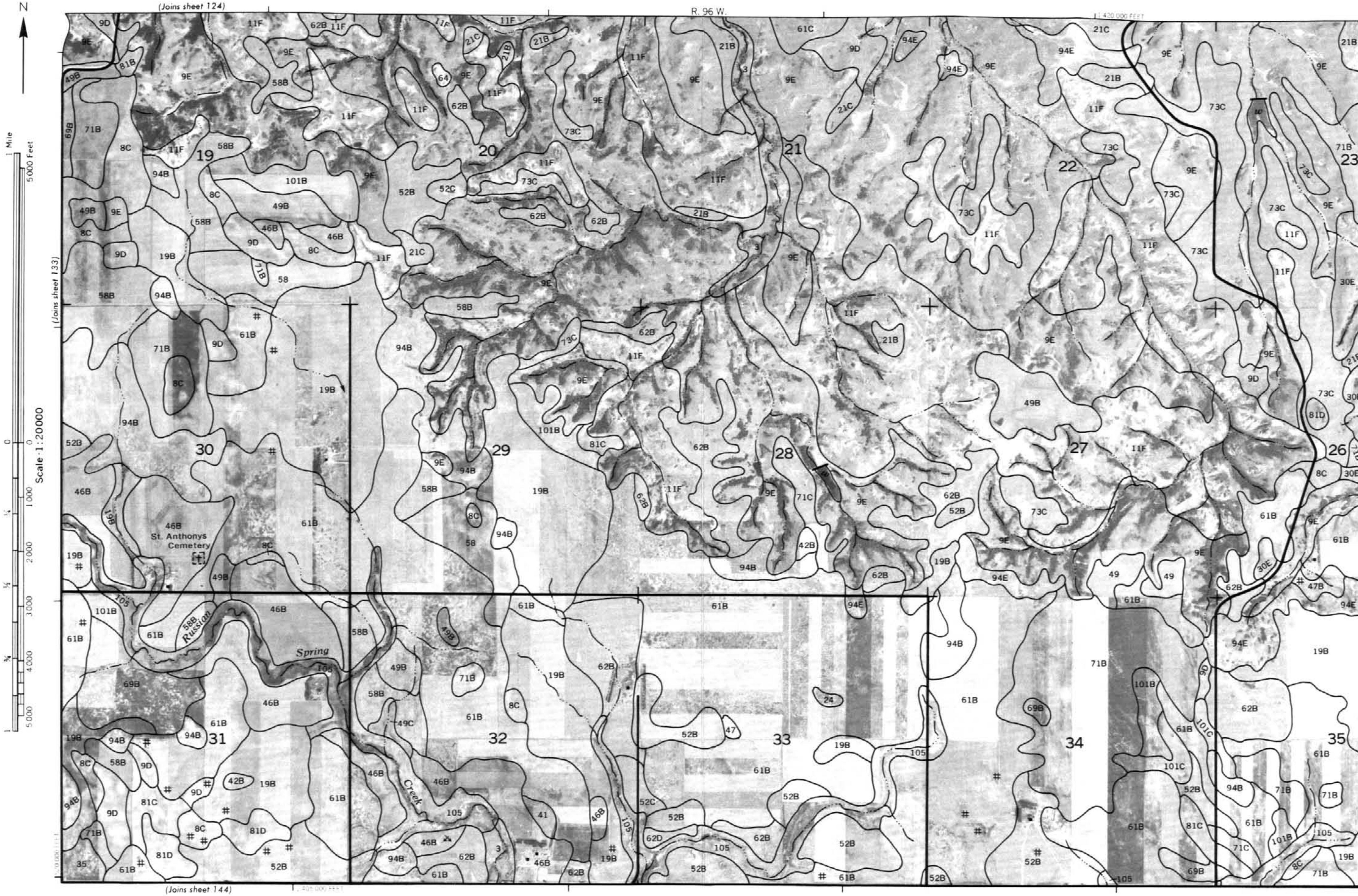
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DUNN COUNTY, NORTH DAKOTA NO. 132

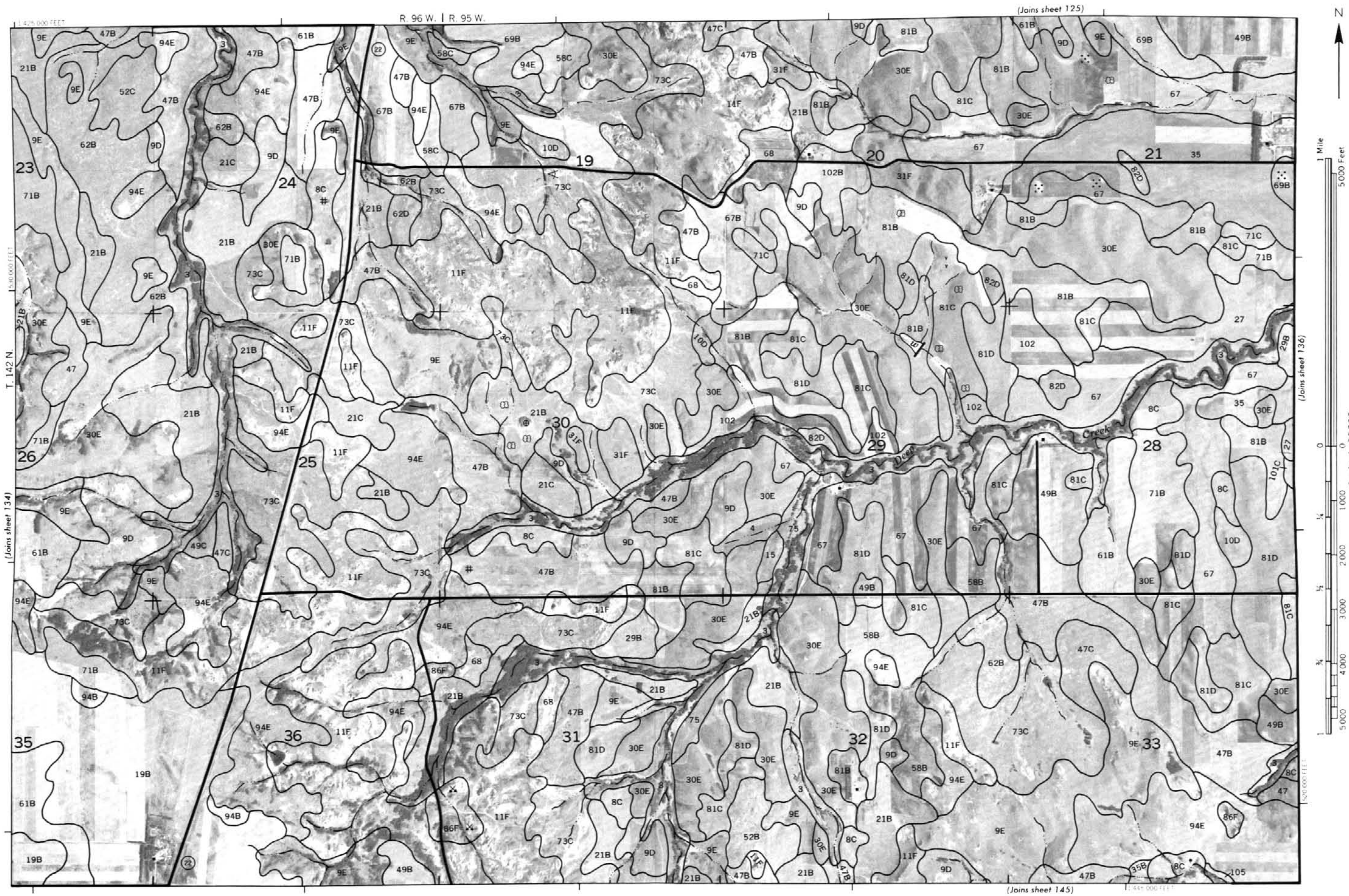


DUNN COUNTY, NORTH DAKOTA NO. 133

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



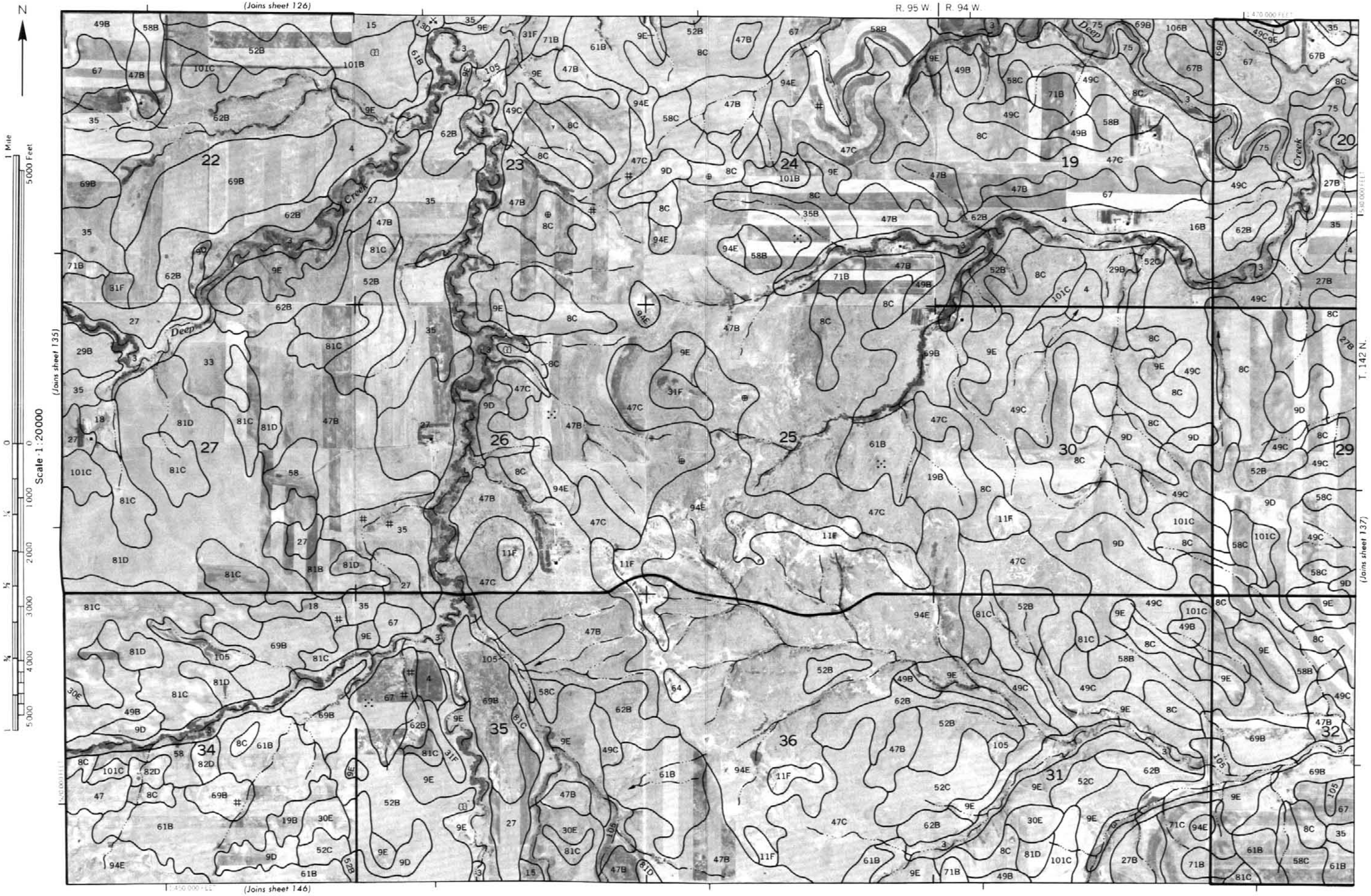
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



DUNN COUNTY, NORTH DAKOTA NO. 135

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DUNN COUNTY, NORTH DAKOTA — SHEET NUMBER 136

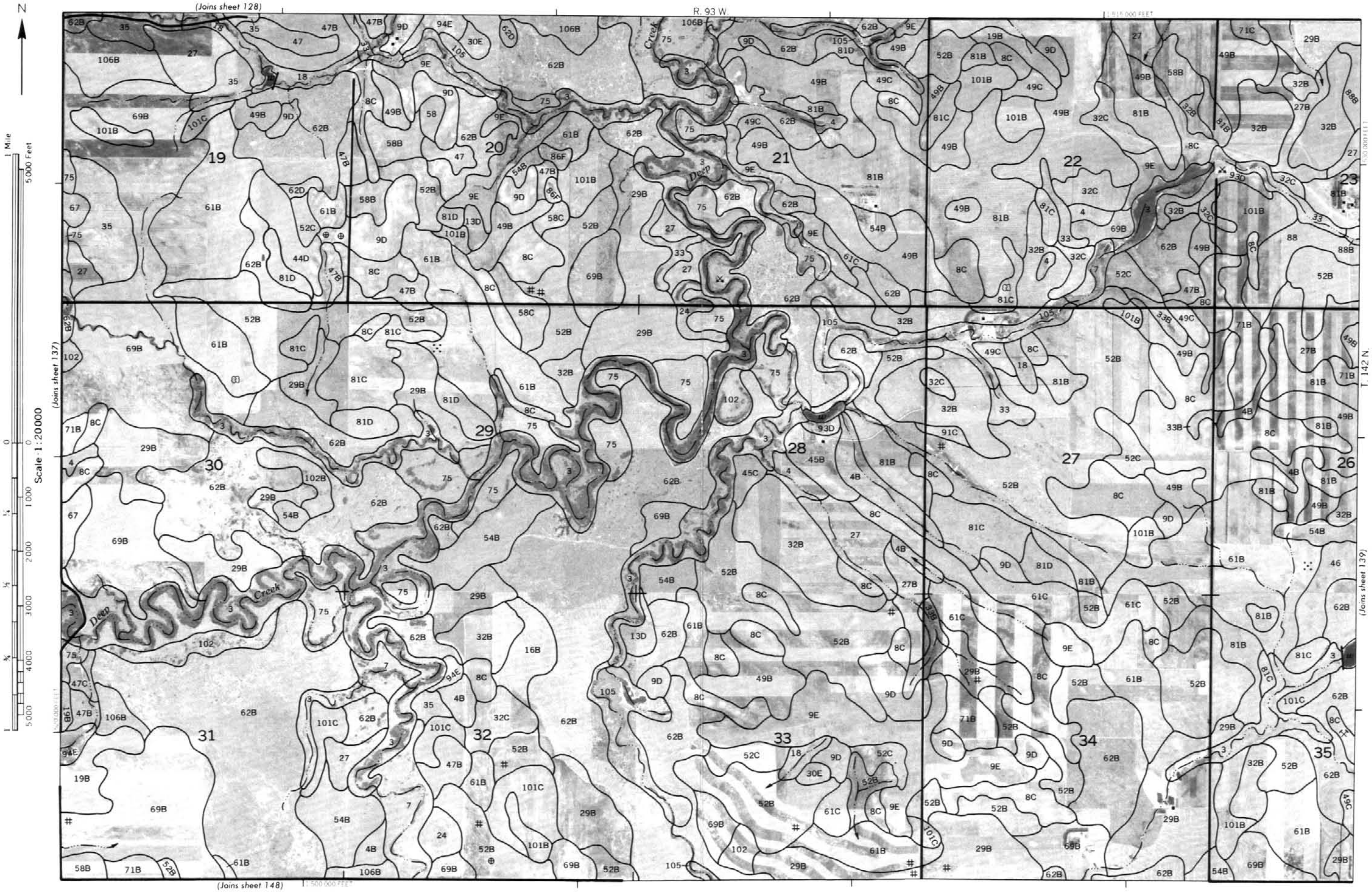


This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DUNN COUNTY, NORTH DAKOTA NO. 136

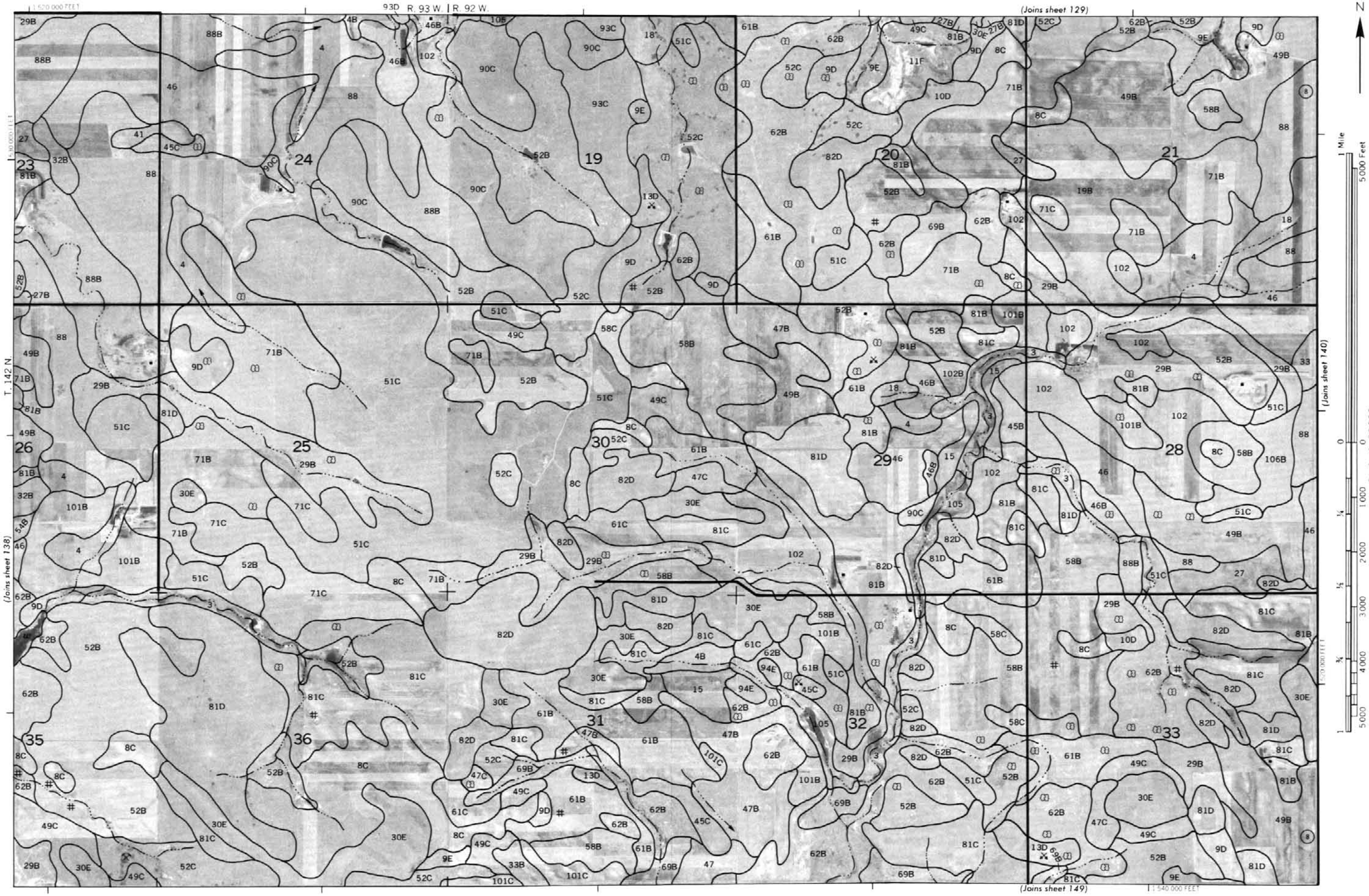
DUNN COUNTY, NORTH DAKOTA NO. 137

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



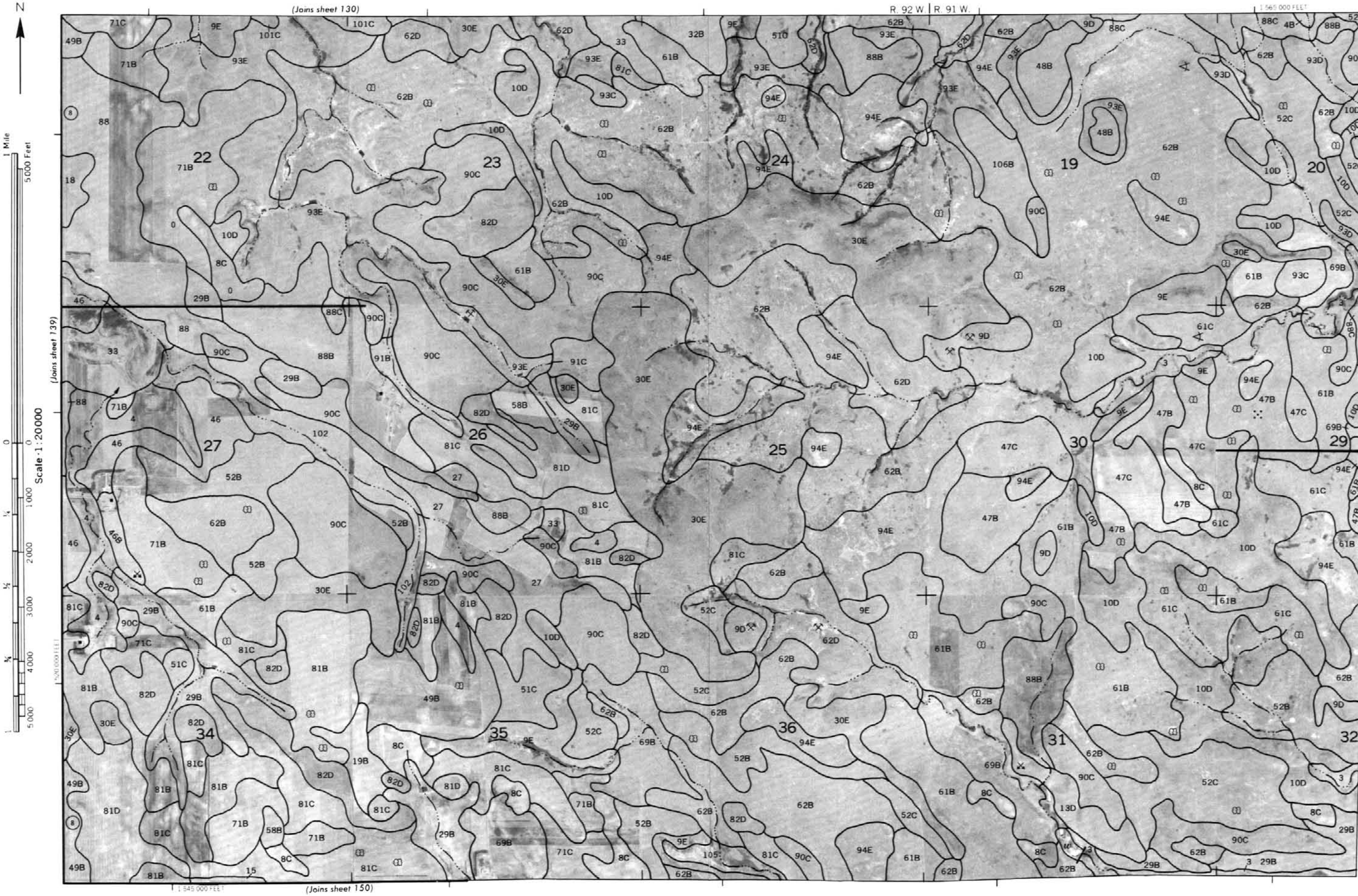
This map is compiled on 1974 aerial photographs by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DUNN COUNTY, NORTH DAKOTA NO. 138



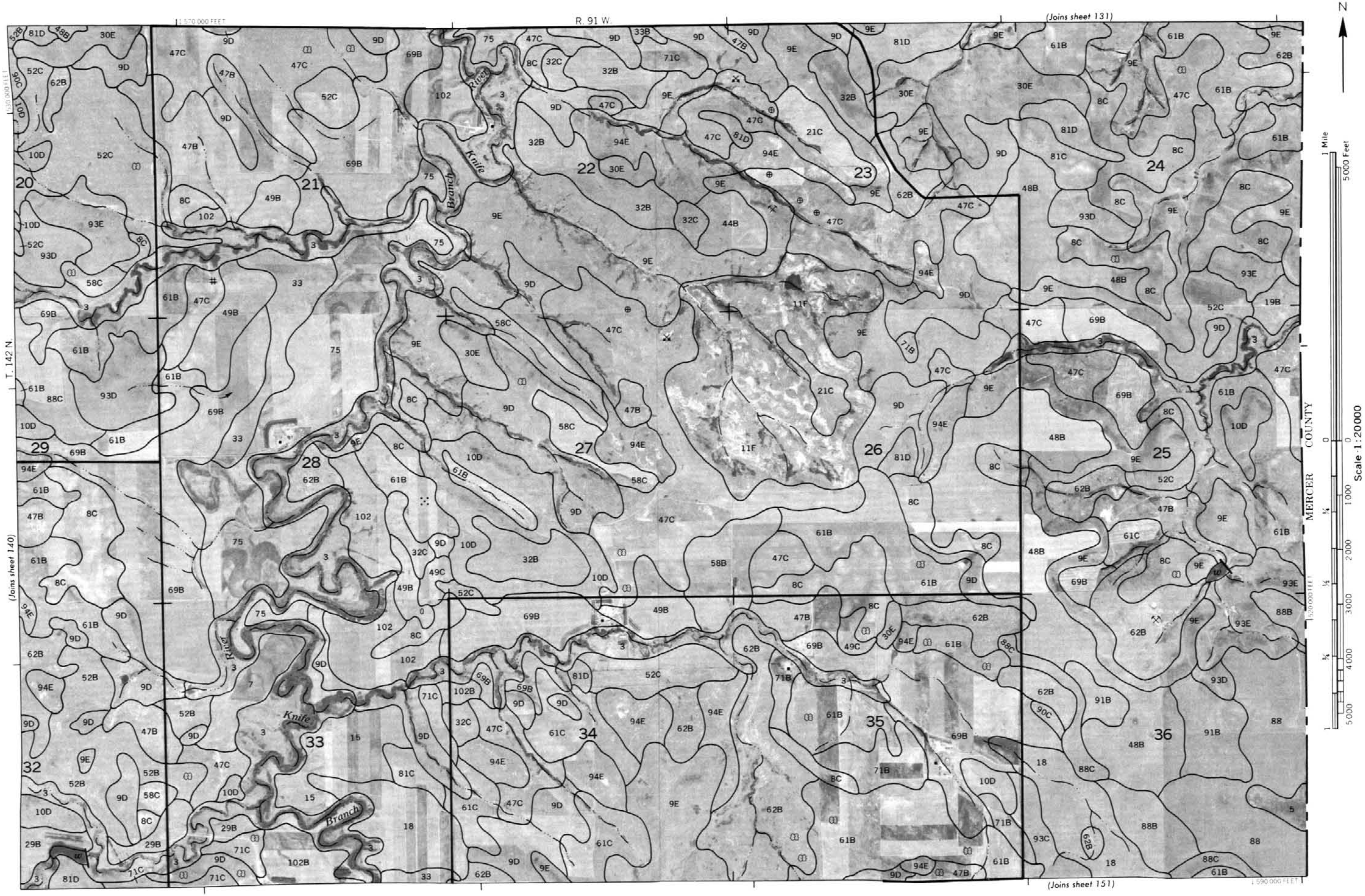
DUNN COUNTY, NORTH DAKOTA NO. 139

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DUNN COUNTY, NORTH DAKOTA NO. 140



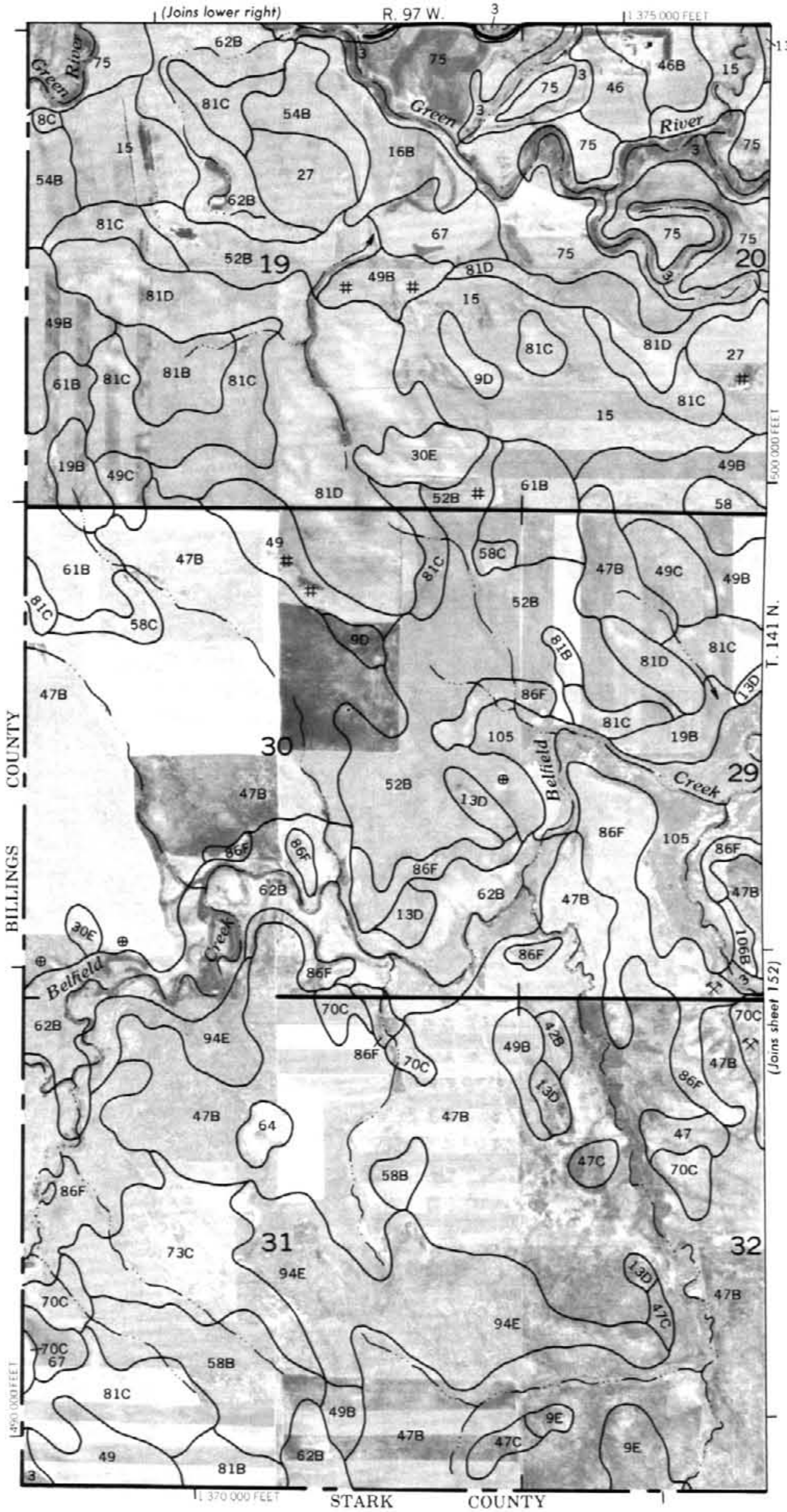
DUNN COUNTY, NORTH DAKOTA NO. 141

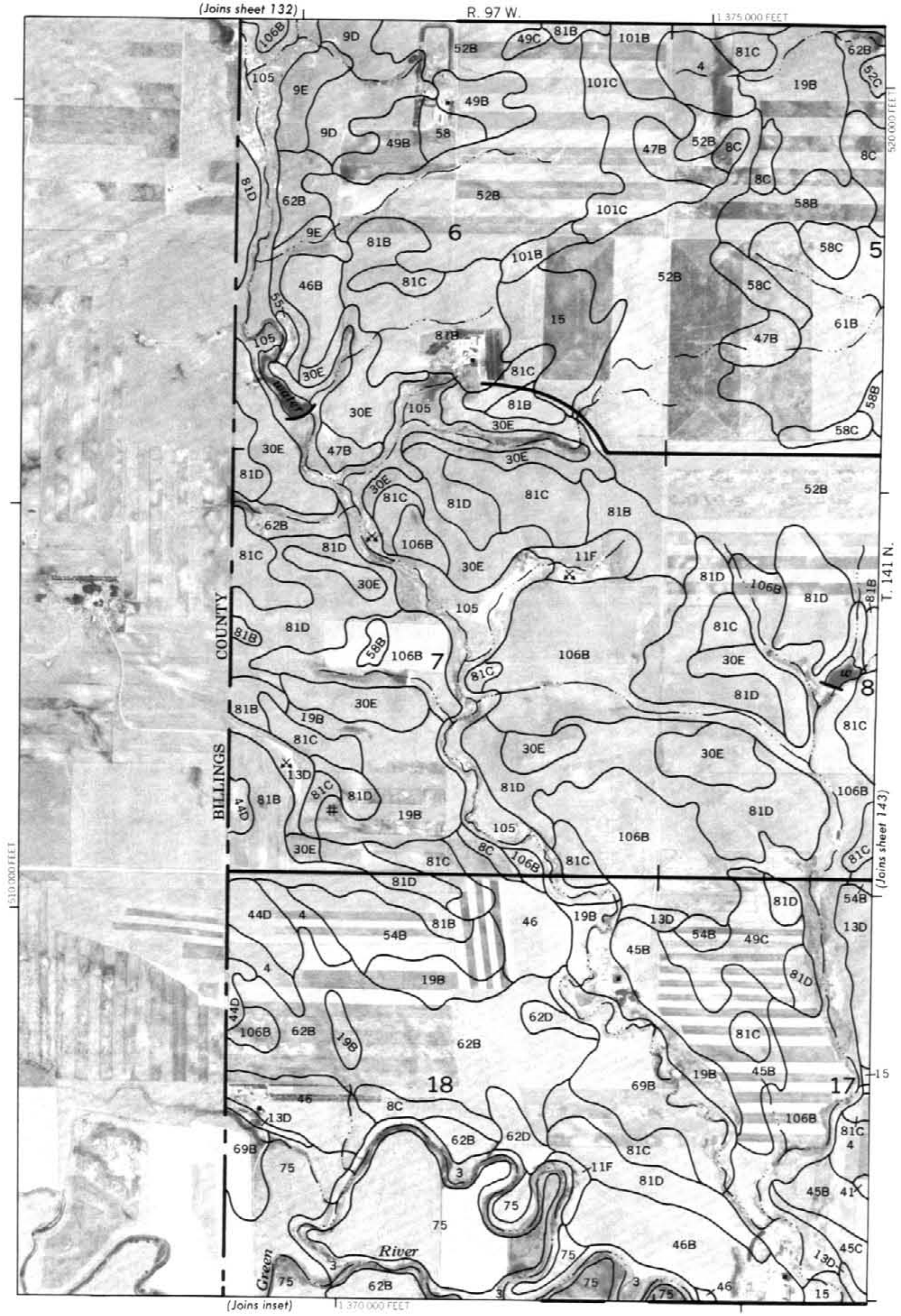
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

N

1 Mile
5000 Feet
1 Kilometer

Scale 1:20000

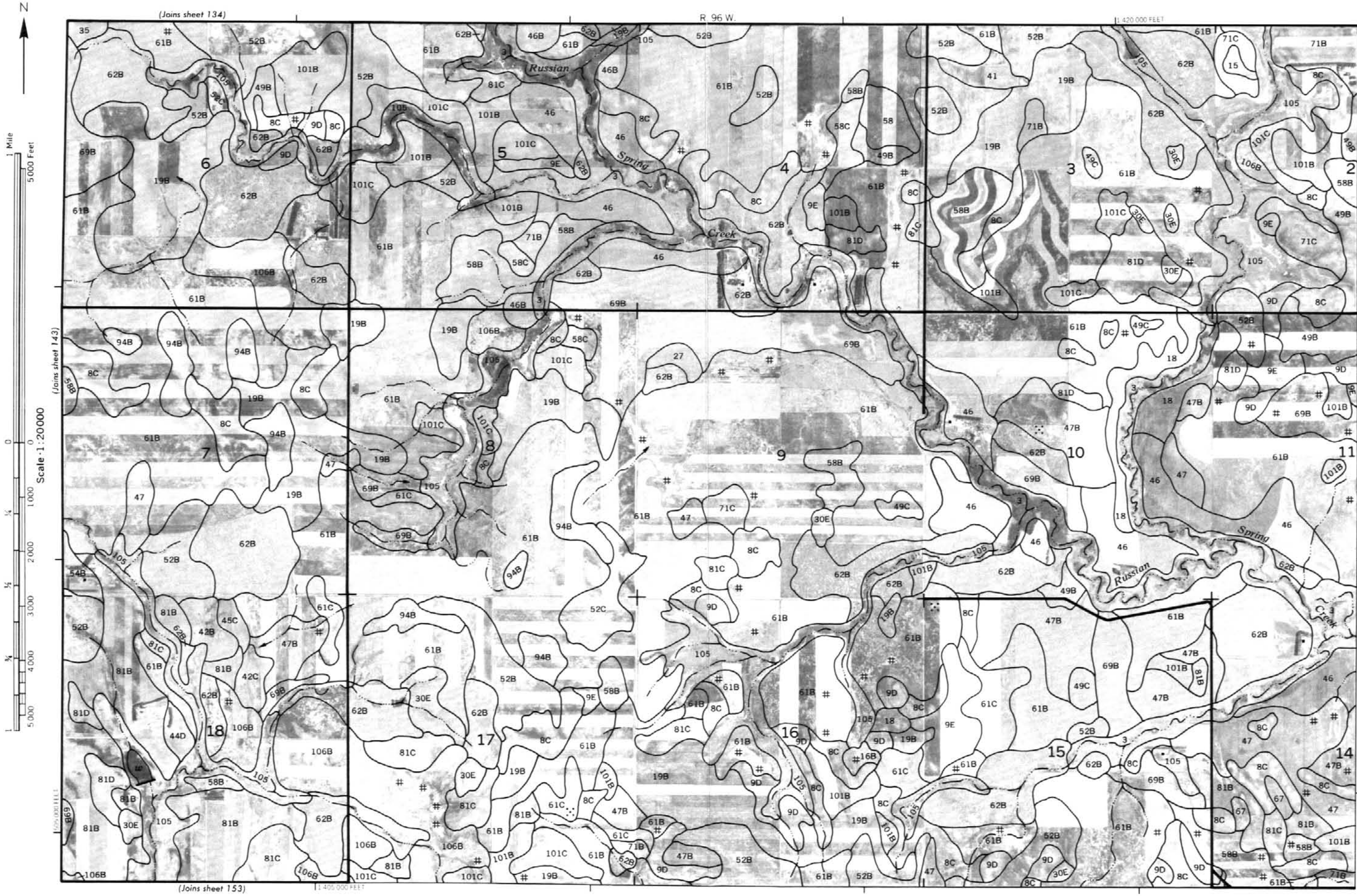


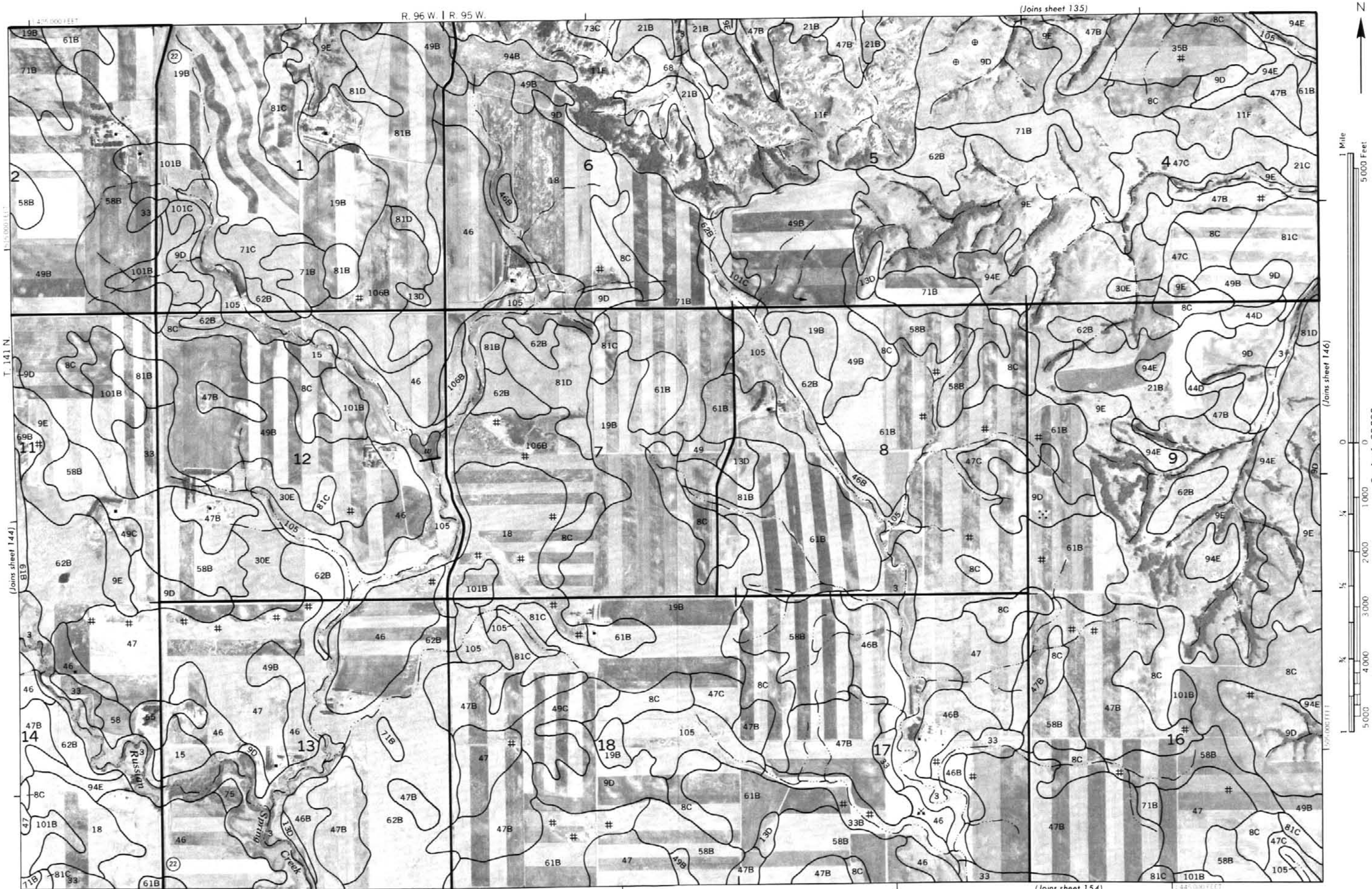


This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

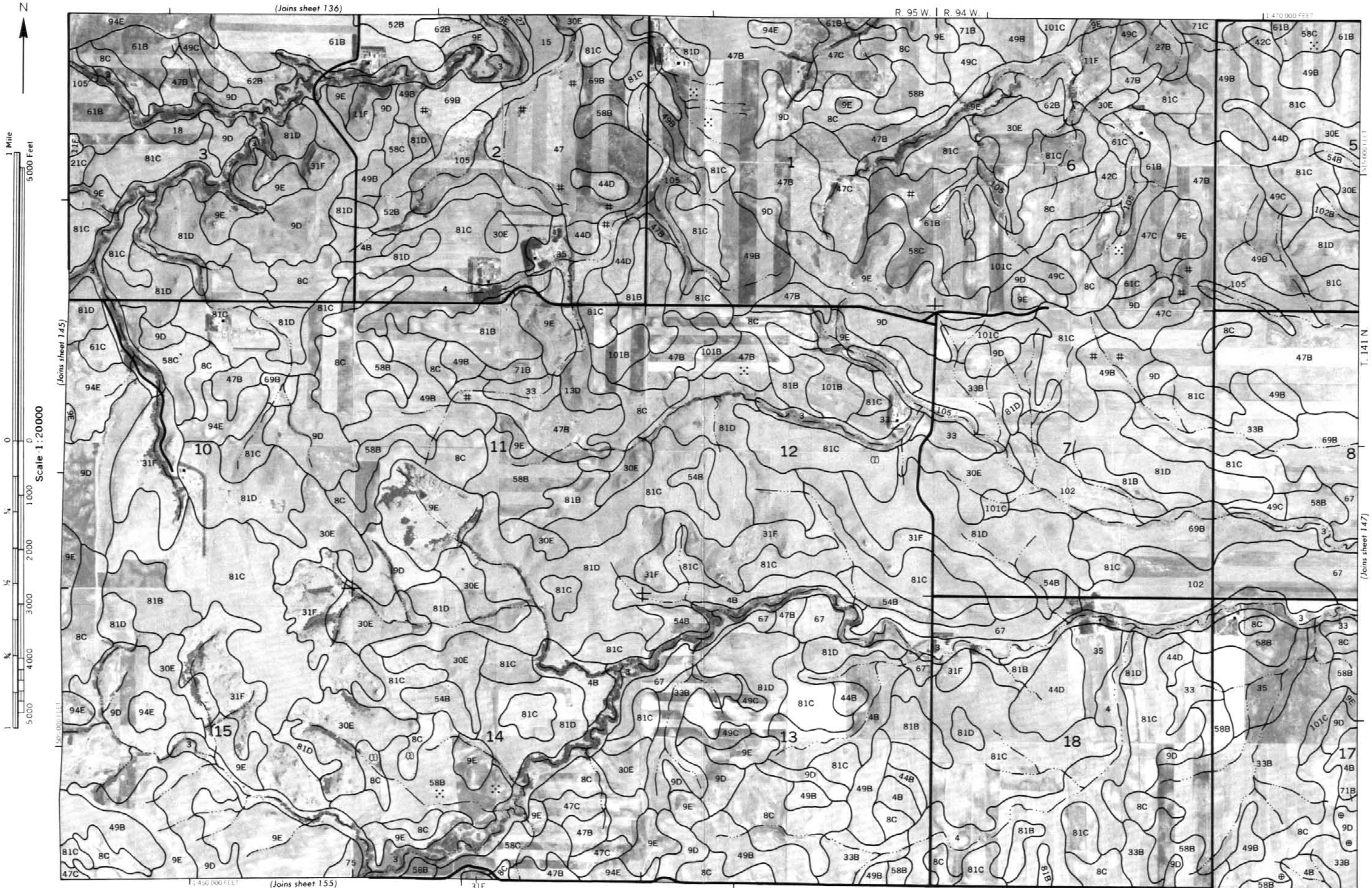
143

DUNN COUNTY, NORTH DAKOTA NO. 143


144
N
(Joins sheet 134)
R. 96 W.
1 420 000 FEET
T. 141 N.
515 000 FEET
(Joins sheet 143)
(Joins sheet 145)
(Joins sheet 153)
1 405 000 FEET
495 000 FEET
Russian
Spring
Creek
1 Mile
5000 Feet
Scale 1:20000
1
2
3
4
5
6
7
8
9
10
11
14
15
16
17
18

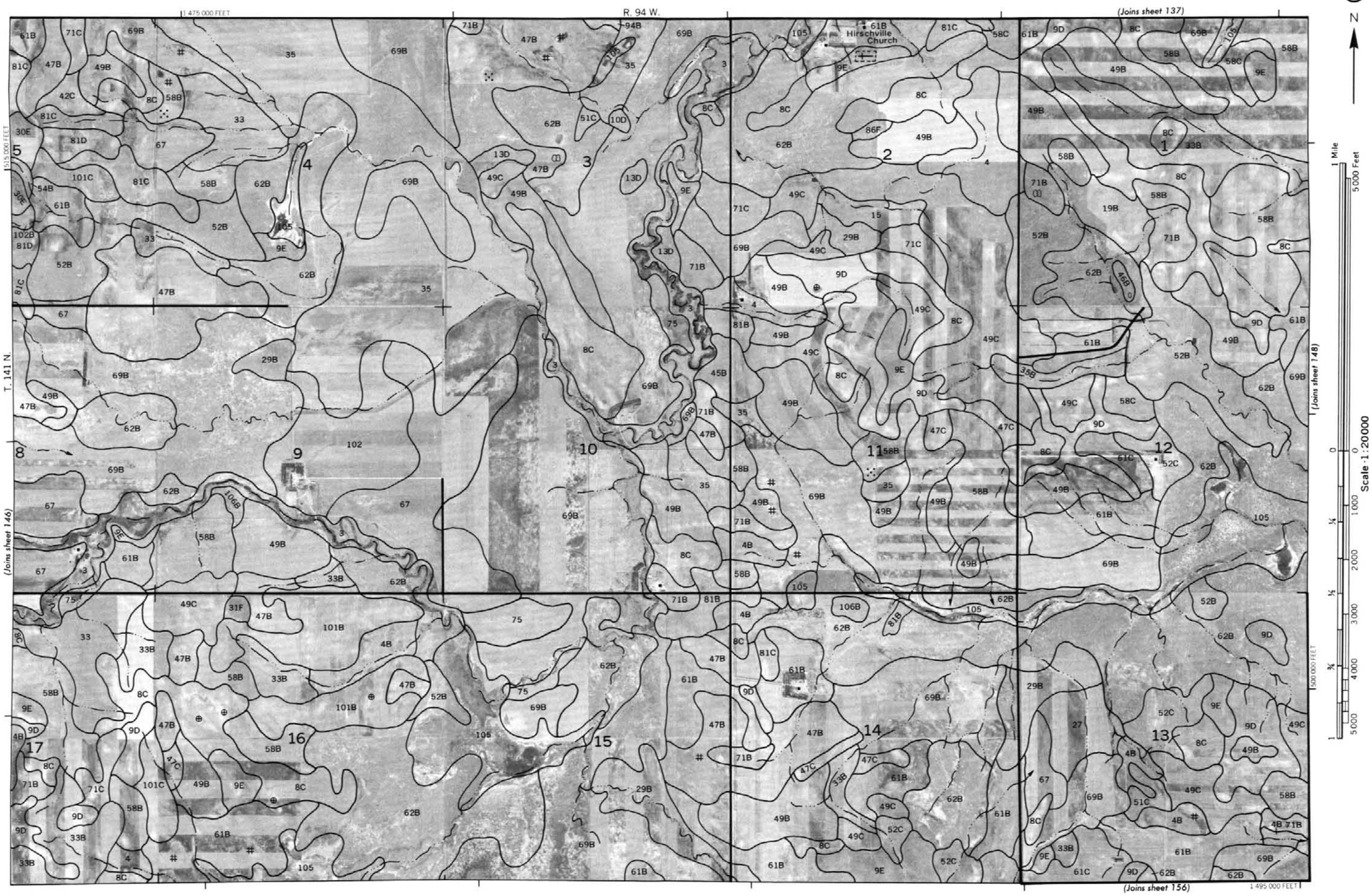


DUNN COUNTY, NORTH DAKOTA NO. 145
This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.



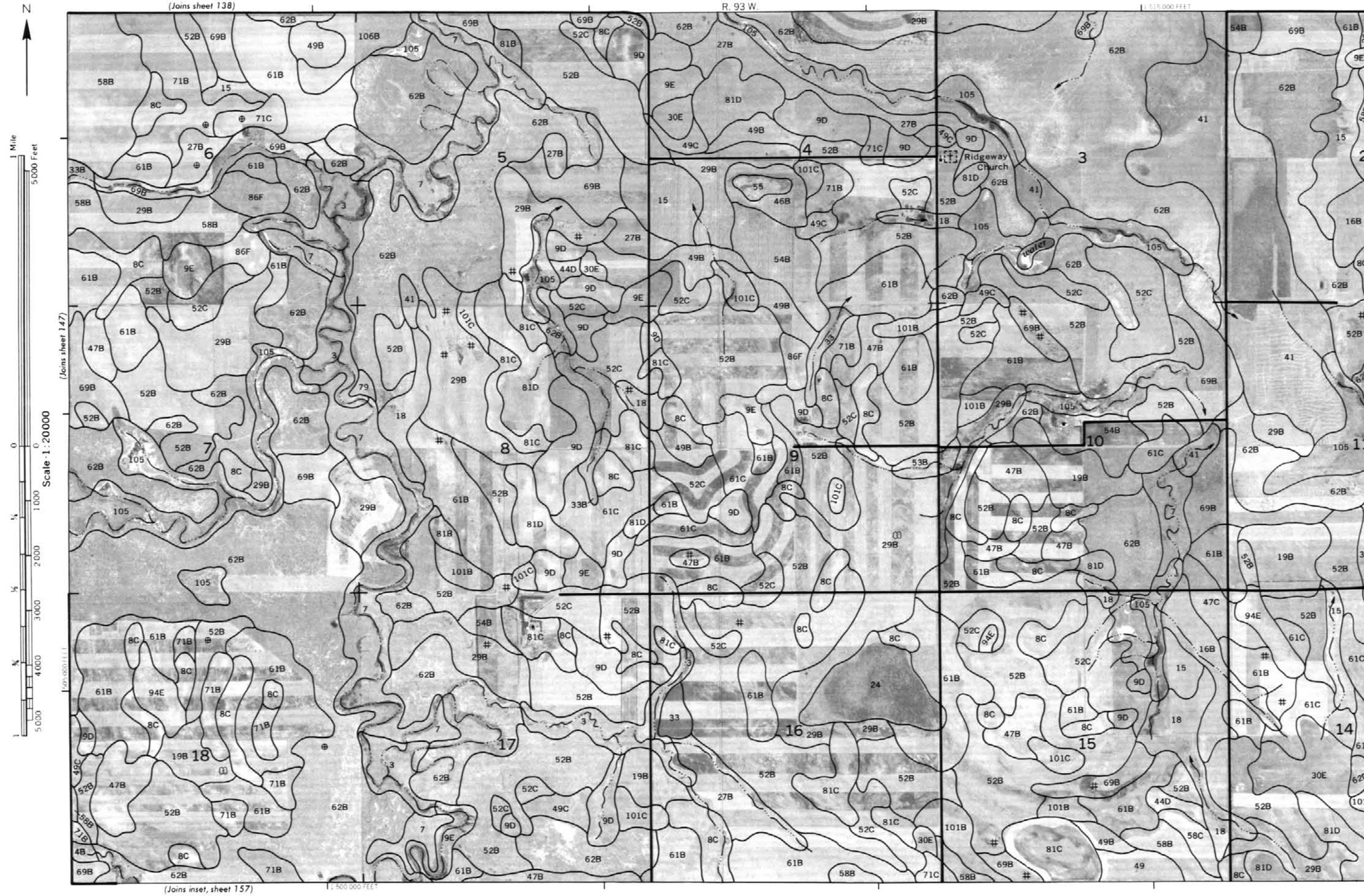
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DUNN COUNTY, NORTH DAKOTA NO. 146



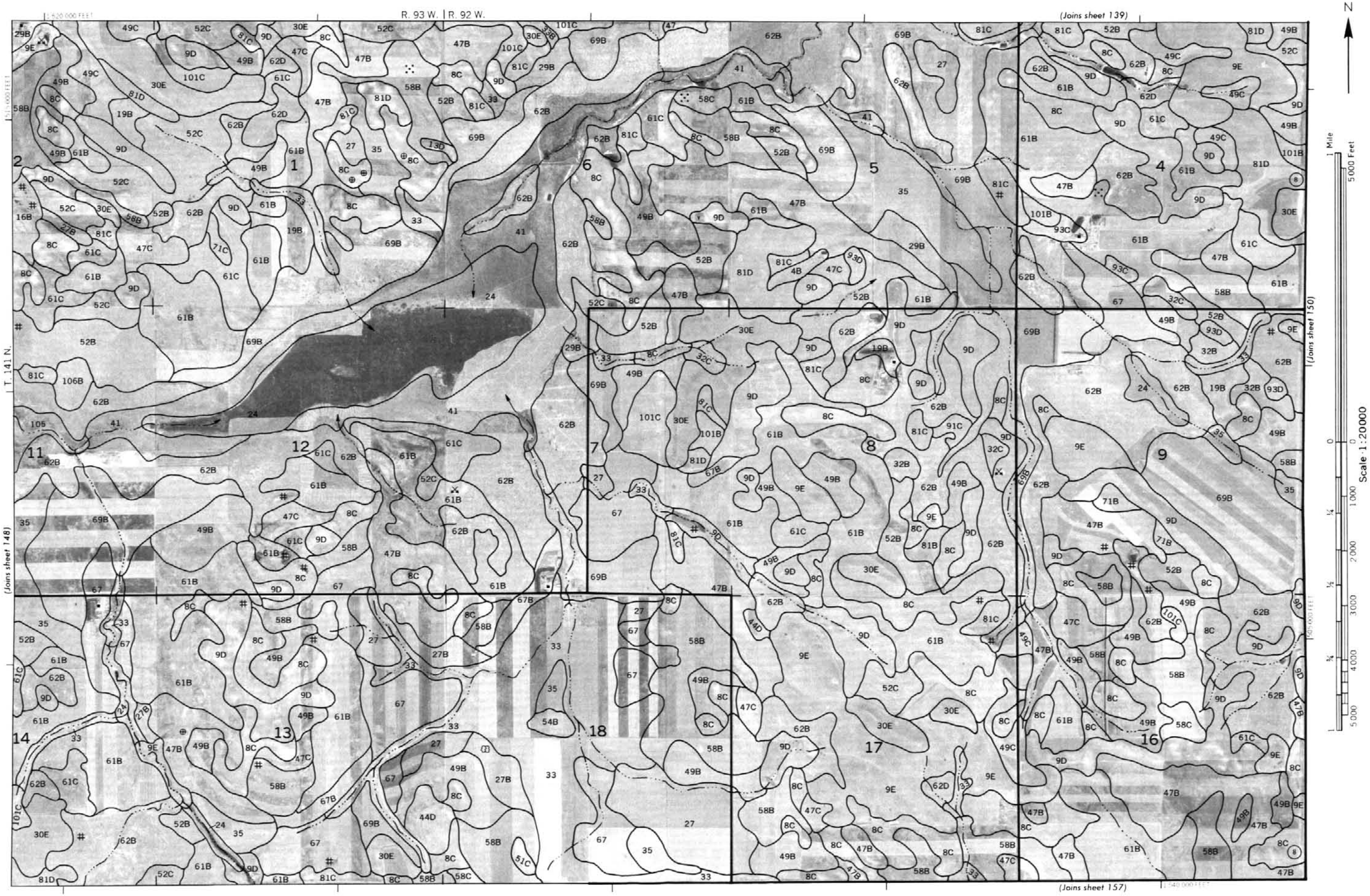
DUNN COUNTY, NORTH DAKOTA NO. 147

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



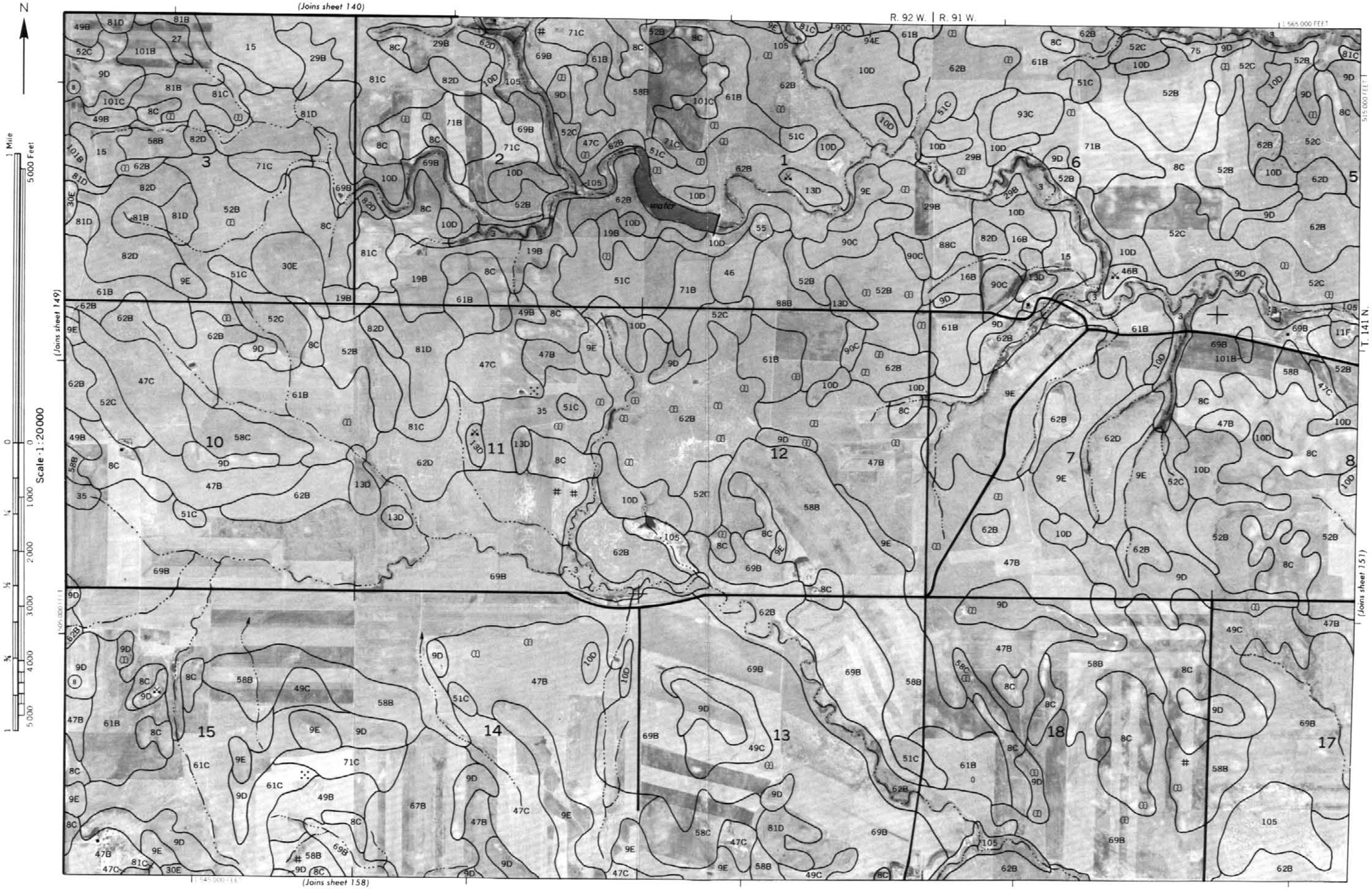
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DUNN COUNTY, NORTH DAKOTA NO. 148



DUNN COUNTY, NORTH DAKOTA NO. 149

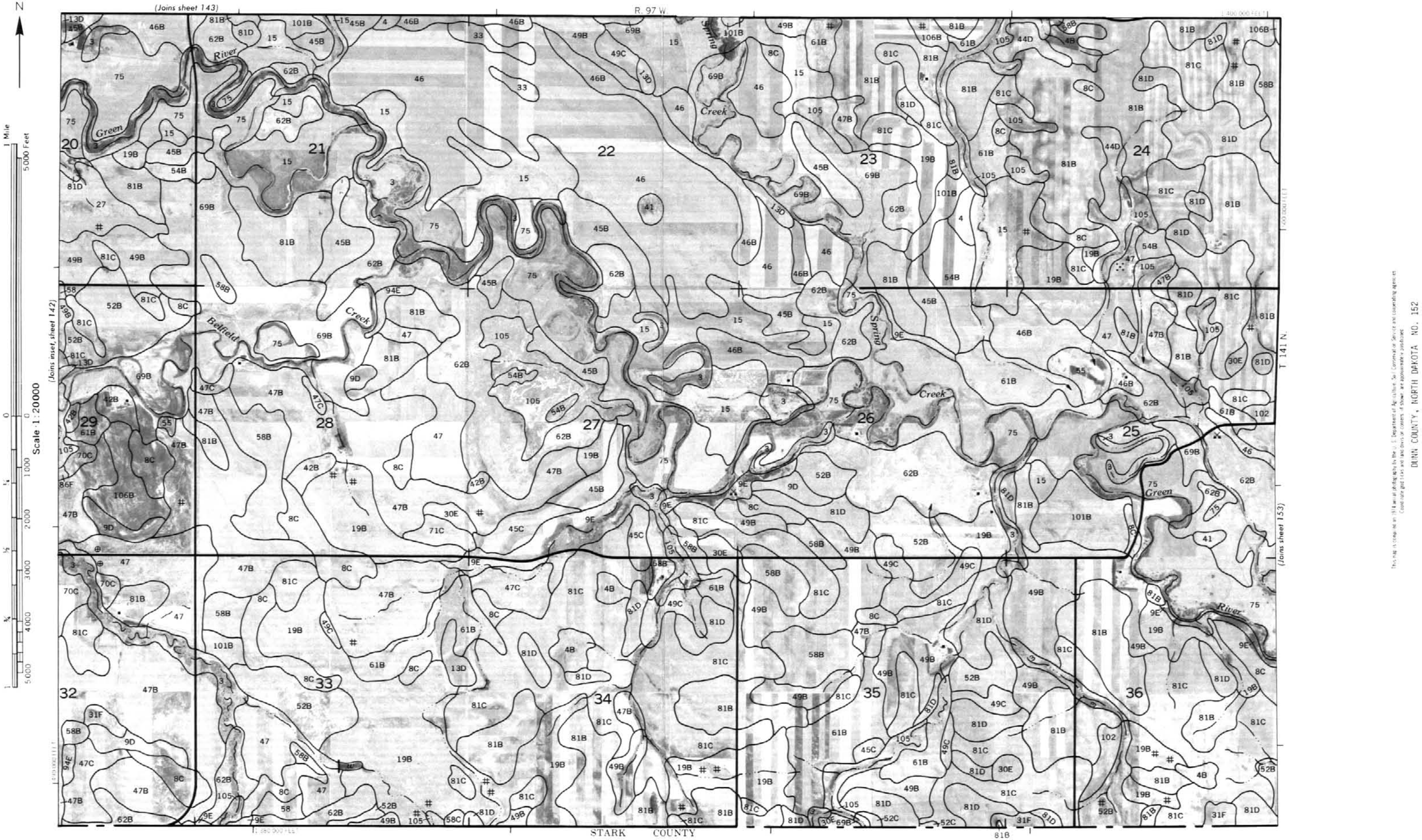
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



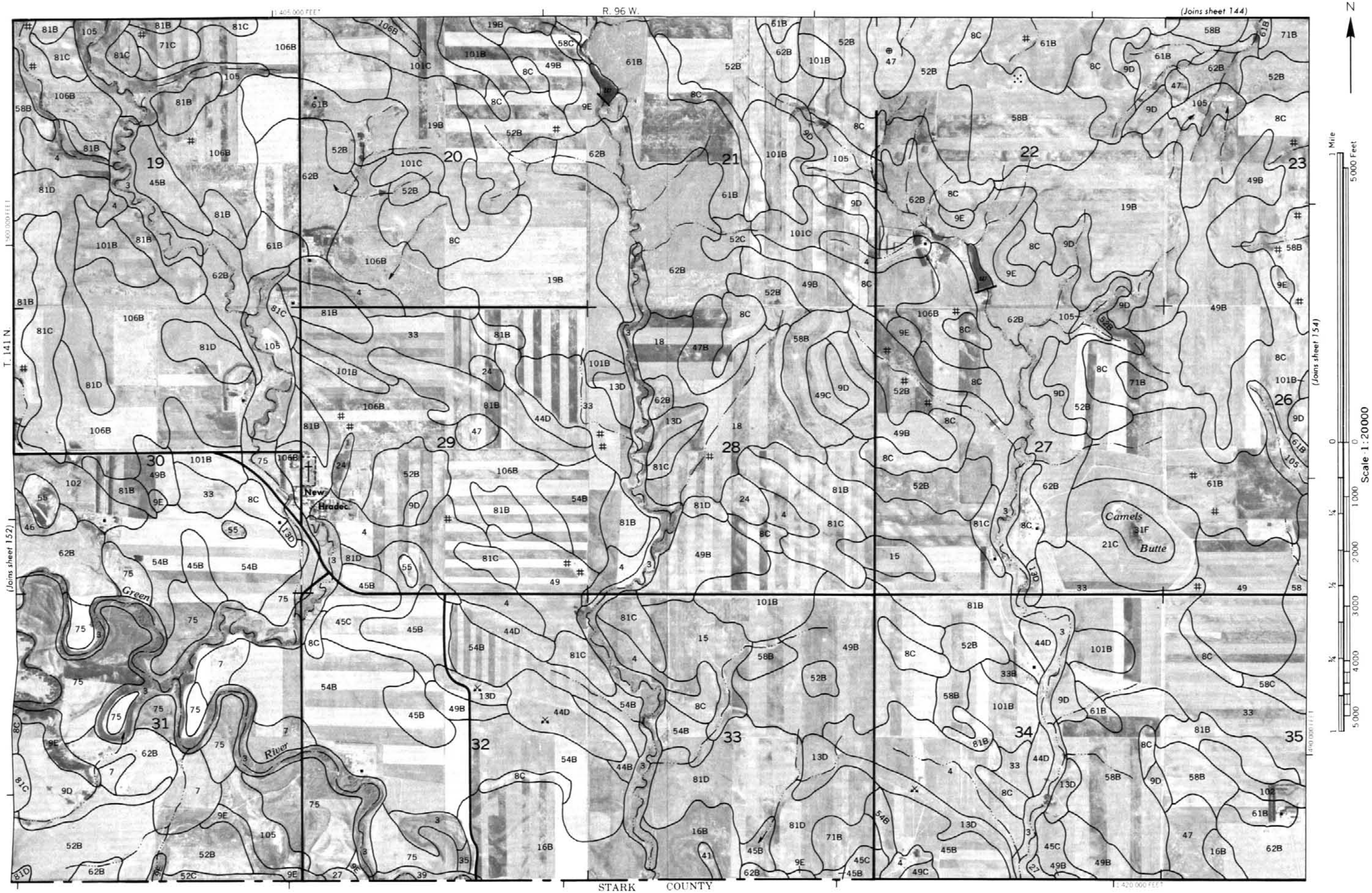
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

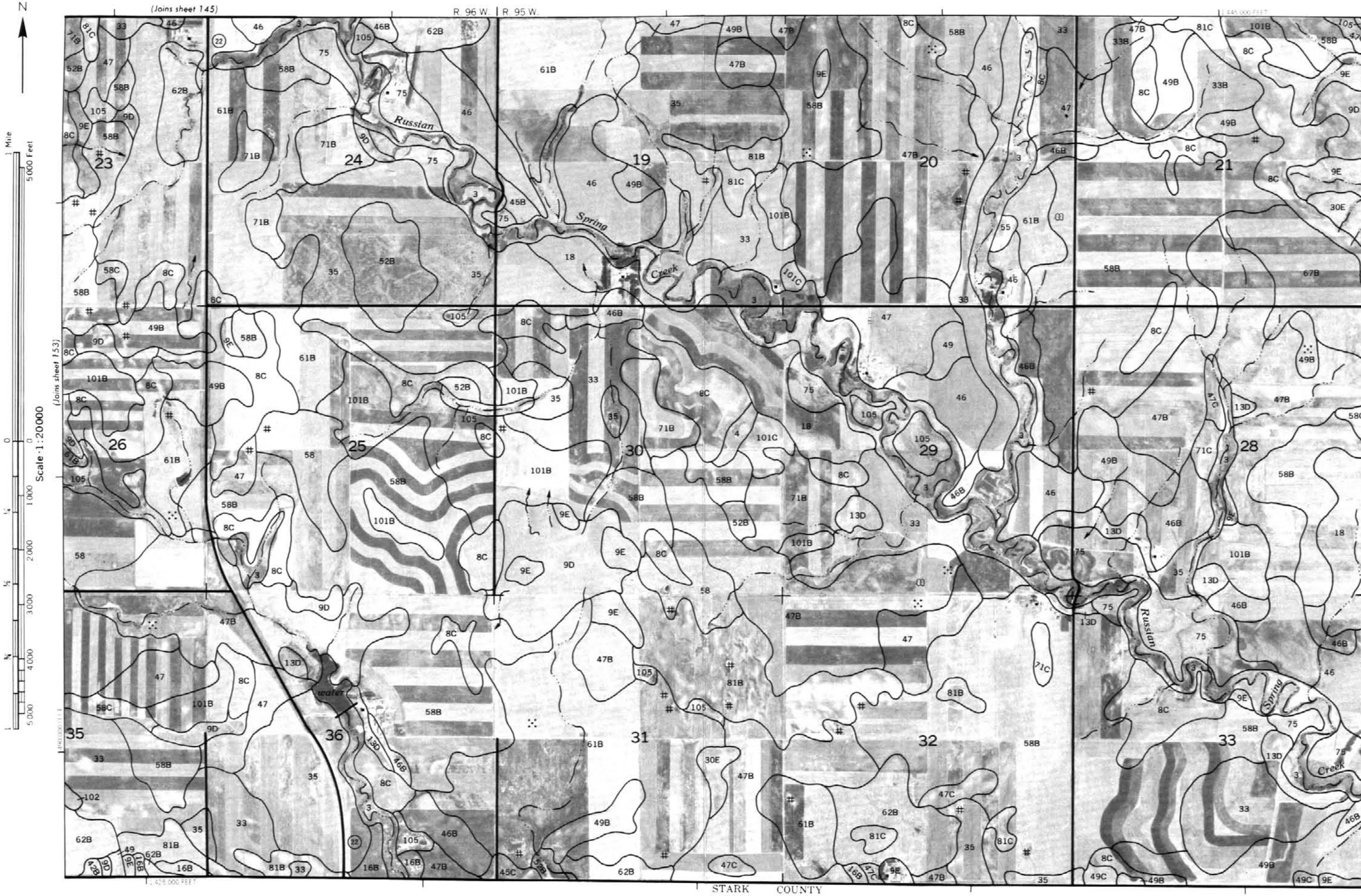
DUNN COUNTY, NORTH DAKOTA NO. 150

DUNN COUNTY, NORTH DAKOTA NO. 151


152
N
(Joins sheet 143)
R. 97 W.
(Joins inset, sheet 142)
(Joins sheet 153)
T. 141 N.
Green River
Belfield Creek
Spring Creek
STARK COUNTY
Scale 1:20000
1 Mile
5000 Feet
DUNN COUNTY, NORTH DAKOTA NO. 152

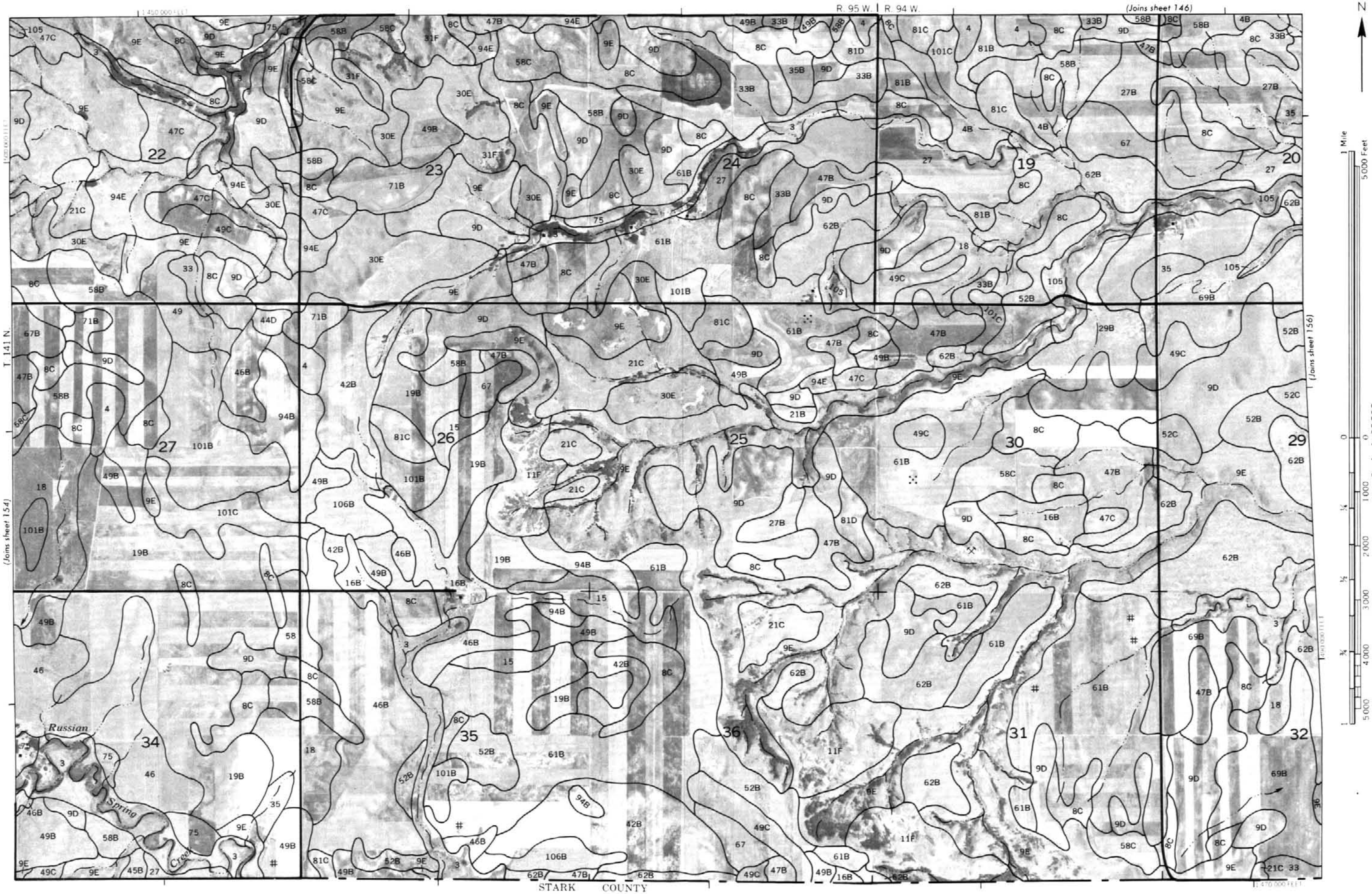
This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.



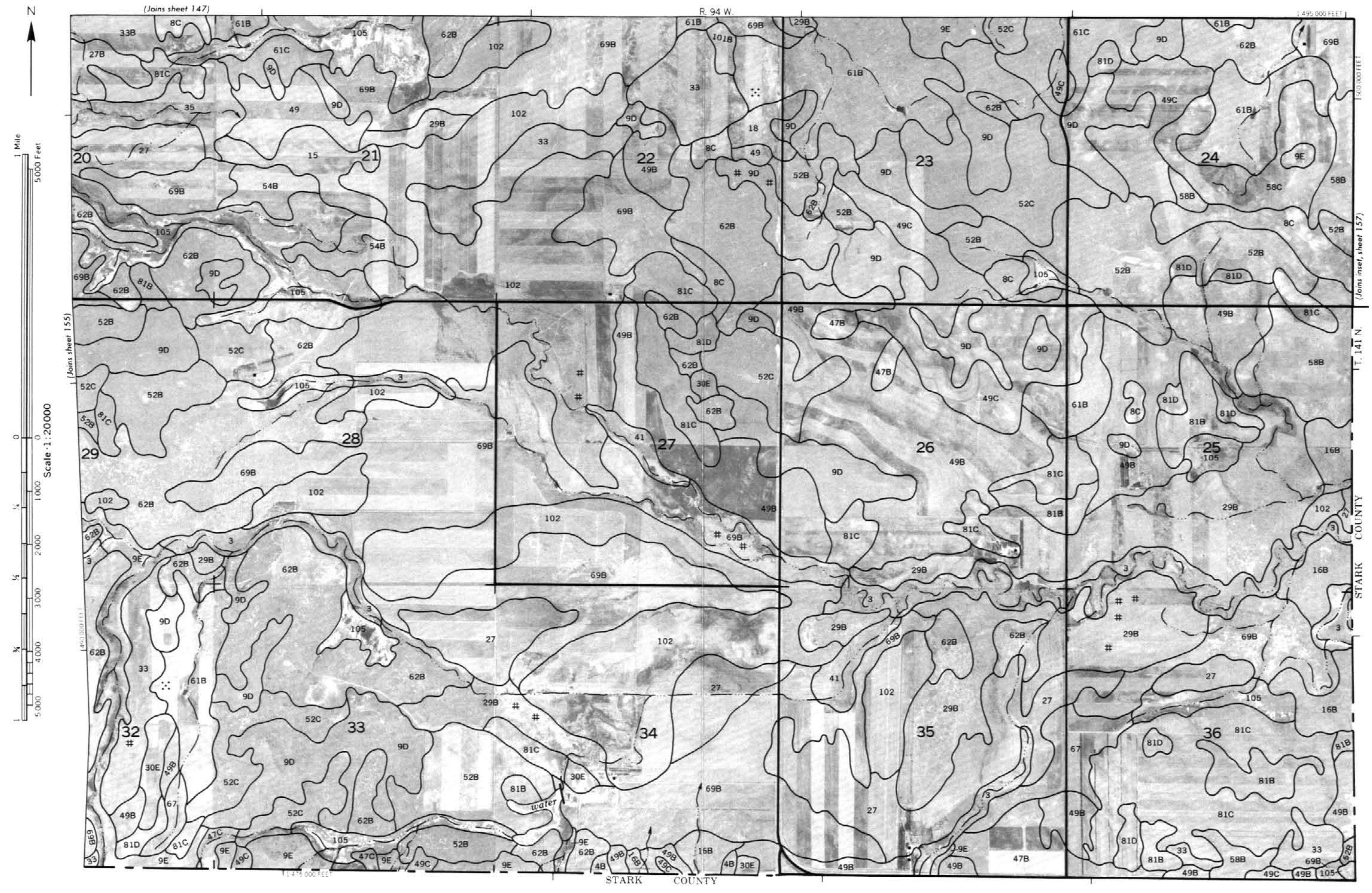


DUNN COUNTY, NORTH DAKOTA NO. 154

DUNN COUNTY, NORTH DAKOTA NO. 155



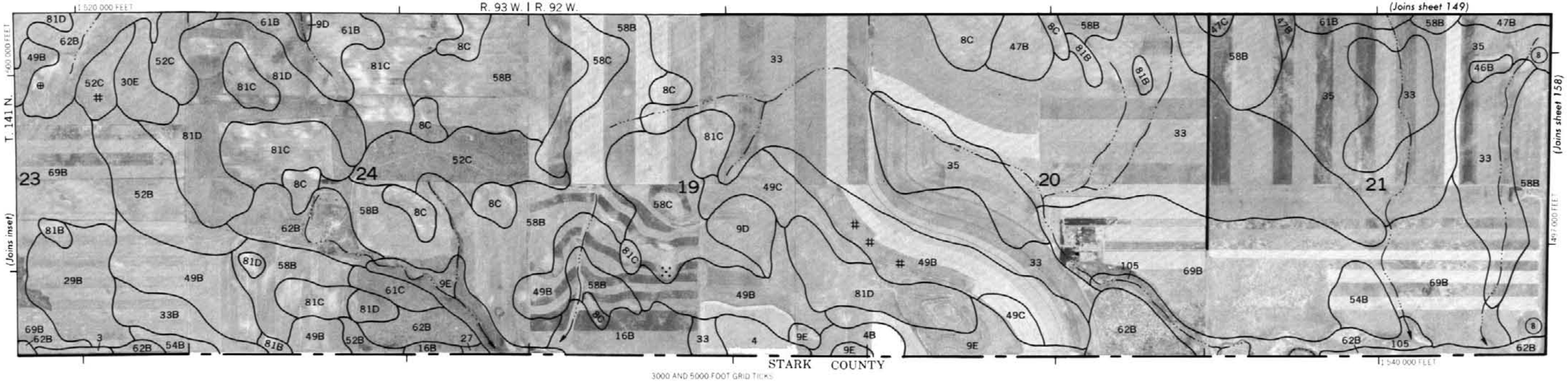
DUNN COUNTY, NORTH DAKOTA — SHEET NUMBER 156

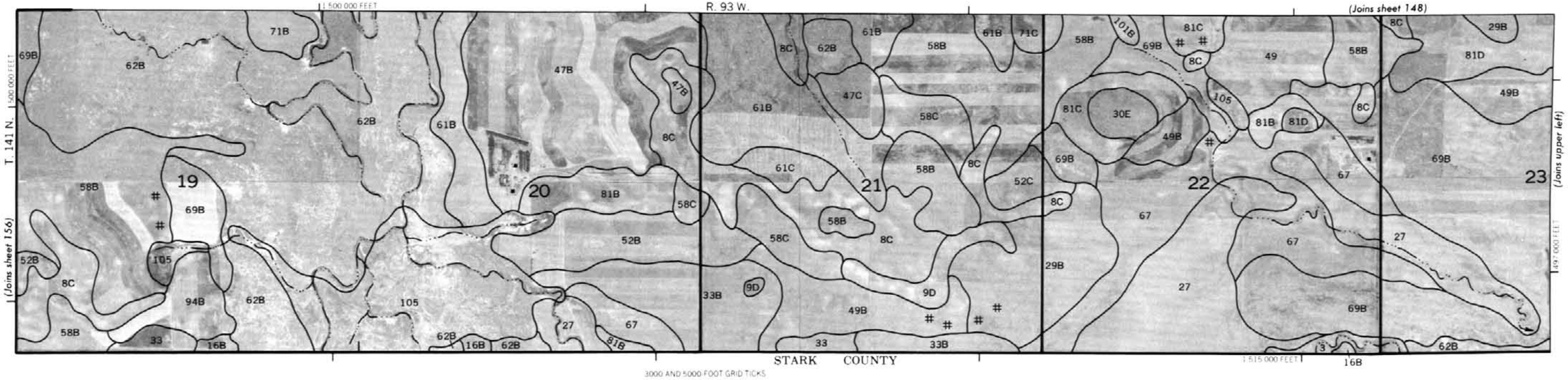


This map is compiled on 1974 aerial photography by the U.S. Department of Agriculture, Soil Conservation Service and cooperating agencies. Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DUNN COUNTY, NORTH DAKOTA NO. 156

157





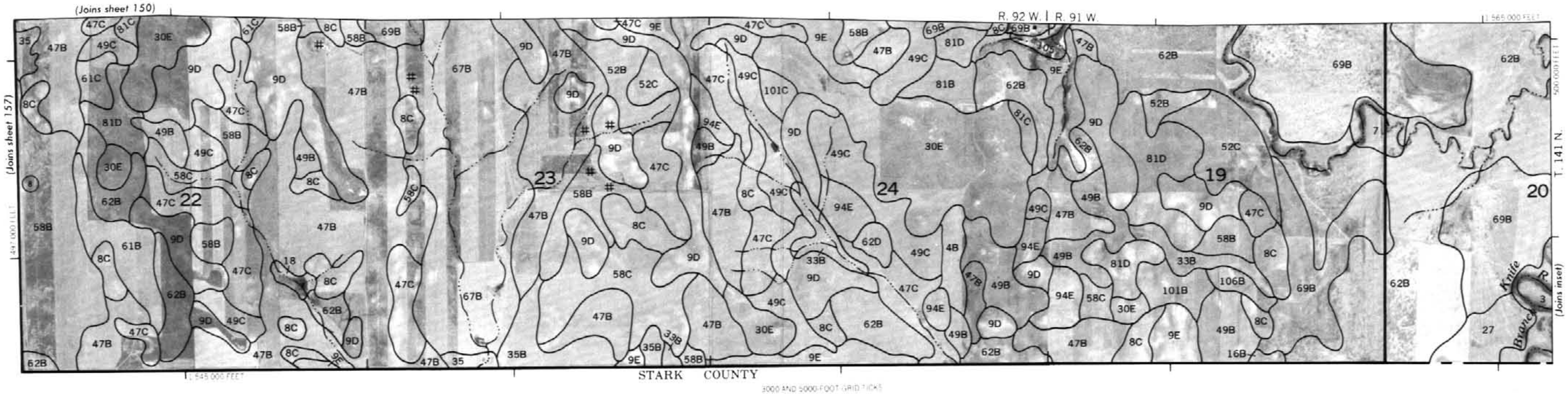
N

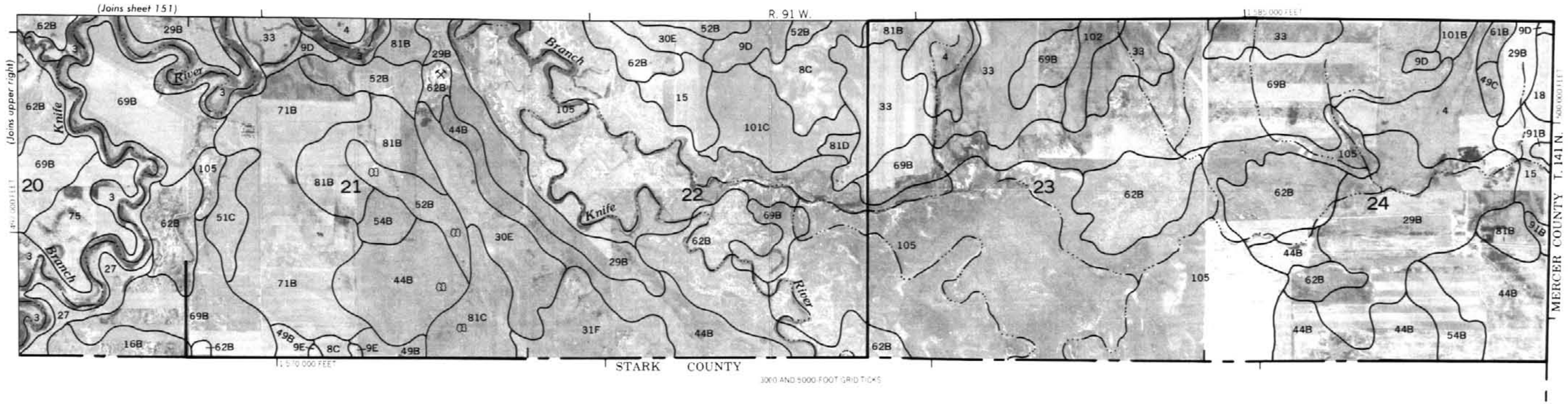
1 Mile
5000 Feet
Scale 1:20000

DUNN COUNTY, NORTH DAKOTA NO. 157

This map is compiled on 1974 aerial photography by the U. S. Department of Agriculture, Soil Conservation Service and cooperating agencies.
Coordinate grid ticks and land division corners, if shown, are approximately positioned.

DUNN COUNTY, NORTH DAKOTA — SHEET NUMBER 158





DUNN COUNTY, NORTH DAKOTA NO. 158